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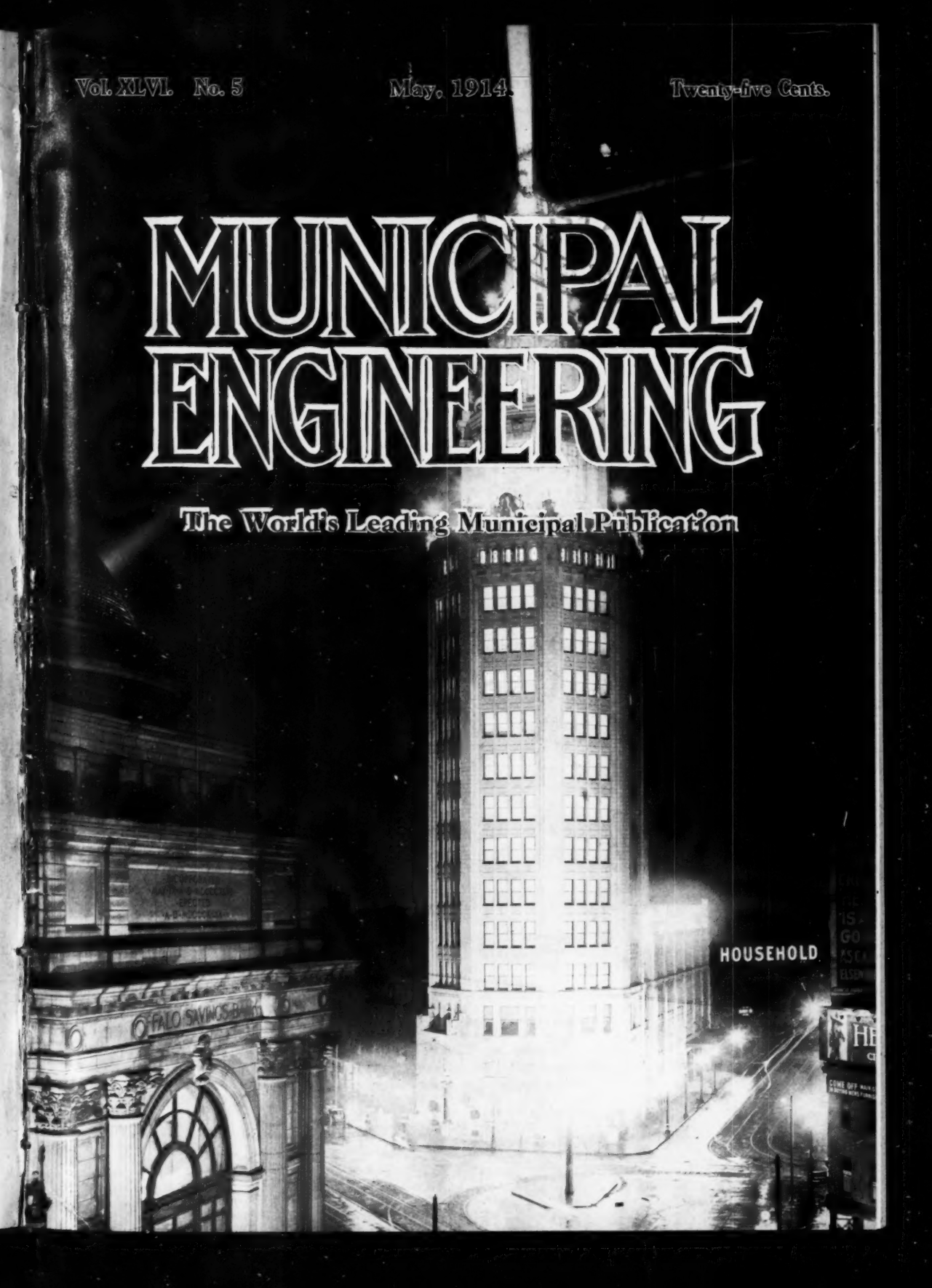

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MUNICIPAL ENGINEERING

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VOL. XLVI. MAY, 1914. NO. 5.

There is an opinion that parties in free countries are useful checks upon the administration of the government and serve to keep alive the spirit of liberty. This within certain limits is probably true, and in governments of monarchical cast patriotism may look with indulgence, if not with favor, upon the spirit of party. But in those of popular character, in governments purely elective, it is a spirit not to be encouraged. A fire not to be quenched, it demands a uniform vigilance to prevent bursting into a flame, lest, instead of warning, it should consume.—George Washington.

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GRANITE BLOCK PAVEMENTS

RECUT TO SMALL SIZE AND RELAID

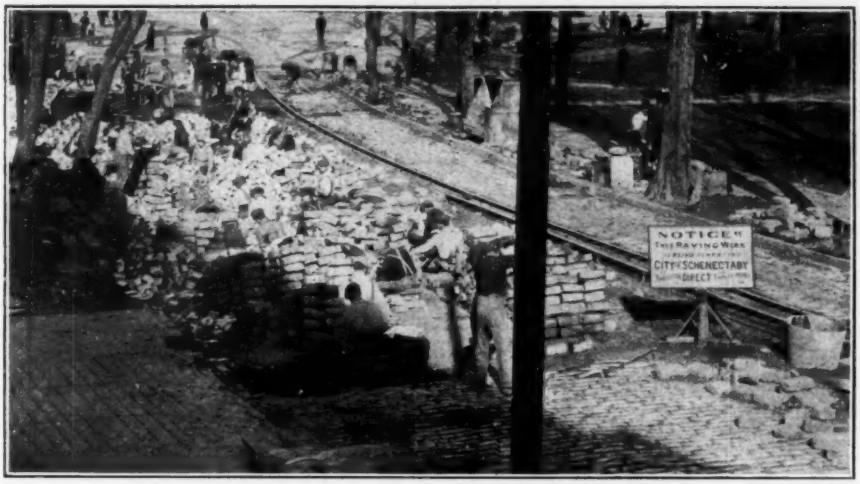
By Charles A. Mullen, Wakefield, Bronx, New York City.

This is a detailed description of an interesting and successful experiment made by the author when he was commissioner of public works in Schenectady, N. Y., whereby he was able to cut the large old-fashioned granite blocks on the streets of the city and relay them to cover double the surface at a very low cost for this expensive class of pavement.

UNLIKE her sister cities, Albany and Troy, that form the other points of the municipal triangle known as the Capital City District, the city of Schenectady has not much stone block pavement. All told, there are probably fifty thousand square yards within the city limits. This, however, does not mean that Schenectady lacked a serious problem in worn-out granite block surfaces, for nearly all of hers were located where their noise and discomfort would not much longer be tolerated. State and Albany streets, on the grades leading from the old business district to the new, could only be traversed with agony to man and beast; and the noise from the worn-out blocks in front of the new Court House made it impossible to hold sessions in the front rooms during weather that required open windows. Many other important points needed urgent attention, and the public insisted that something be done to relieve the intolerable conditions.

The budget appropriations for 1913 provided about $50,000 for street pavement maintenance, and it was decided to spend approximately half of this to make some very radical changes in these old granite block surfaces. The next question was how it should be done, and this proved a matter that could not be determined satisfactorily without considerable study. The writer had seen the old blocks taken up, broken in two across their lengths, dressed and relaid in a sand cushion upon a new concrete foundation, with cement grout joints, as it is done in the Borough of the Bronx, New York City, and elsewhere. He had also tried, in Milwaukee, breaking the old blocks the Bronx way and laying them upon a dry small-stone concrete mixture, afterwards wetting this concrete foundation thru the joints of the blocks before grouting, and this method proved fairly satisfactory. It seemed, however, that much greater improvement in relaying granite block surfaces might be possible; and, therefore, some experiments were made before the Schenectady work was started that developed a new method of breaking, dressing and laying the blocks that we thought better than any then in use. Better in the pavement surface produced, and of far greater paving economy.

As soon as spring weather appeared, a stone cutter was taken to a lot on which some old stones were lying and directed to break blocks, first one way, then another, until it seemed that blocks had been broken in every possible size and direction. It developed, from this experiment, that the most satisfactory result could be secured by breaking each old block, measuring about twelve inches in length, eight inches in depth and four inches in width, into four new blocks, each measuring about six inches in length, four inches in depth and four inches in width; that is, by halving the



REPAVING *State street around Crescent Park, Schenectady, N. Y. Old granite large block pavement in foreground. Cutting old blocks into smaller sizes in the middle ground, and laying the new small block pavement in the background. All stages shown within 200-foot length of street.*

length and the depth, which gives one-half the surface thickness and twice the surface area in the new pavement as compared to the old. The blocks that are very large or very small, and will not break to advantage as described above, receive special treatment at the hands of the cutters. Sometimes the first block is taken from the length, and the remainder makes two by dividing the depth; sometimes all the blocks are taken from the length of the old block. In actual practice, as afterwards tested, the new blocks measured from five to eight inches in length, from three and three-quarters to four inches in depth, and from three and one-half to four and one-half inches in width. These blocks pave very regularly, and to a remarkably good surface. In doing his work, the block maker usually sits on an old stone, throws the block he is to break between his legs with its side resting on the ground, marks it across the length on the uppermost side with a sharp-edged tool called a tracer that he strikes with a hammer weighing about four pounds, then breaks the block by turning it over and striking directly opposite the marking with a hammer that weighs from eight to ten pounds. Each half thus produced is next broken across the former depth of the old block in the same way, and the resulting quarters are dressed into new, high-class little pavers. The amount of waste in this process, as evidenced by the chips and bats remaining when the work is done, is surprisingly small, and this is broken up and used in the concrete. The 100 per cent. increase in surface area of the blocks, to a city that has real paving economy at heart, is a very important consideration. It means a saving of more than $1 per square yard over the amount of money new granite blocks of equal value would cost for some other street needing this type of pavement. It also means home labor employed in doing the work.

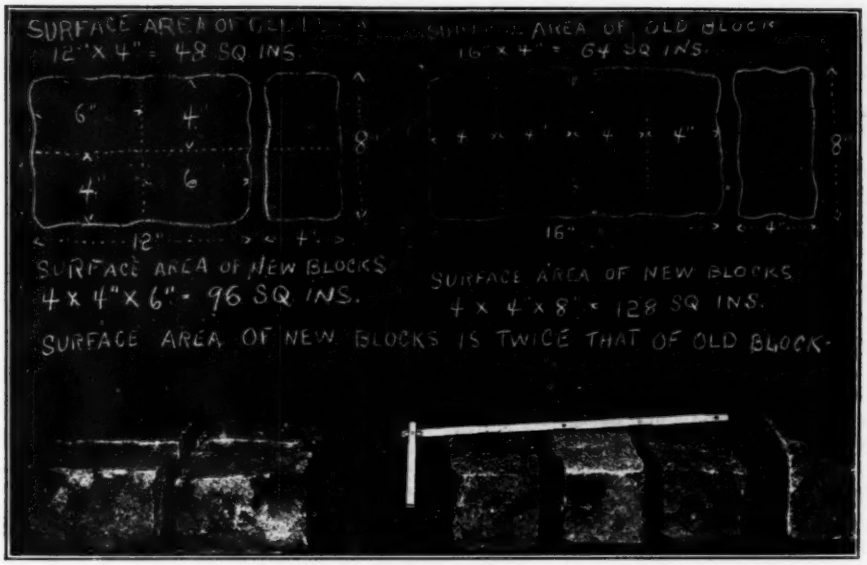
The old granite blocks from Lower State Street, where a wood block pavement was laid, the only one in Schenectady, at the abutting property owners' request, expense and later regret, were taken to the Albany street grade, where they were recut, dressed and laid upon the old concrete foundation from which an asphalt block surface, ten years old and in tatters, had been removed. A mortar bed was placed under these blocks, in some places three inches deep because of the defects in the old concrete, and

the joints cement grouted. All the other recut block pavements were laid in places where there had previously been no concrete, or where the old concrete had to be removed because not at the grade proposed for the new work.

The roadway shown in the accompanying photographs, that of State street around Crescent Park in front of the new Court House and the State Armory, is typical of those relaid by the new process of cutting and dressing. In one photograph, the entire work is shown in progress, from the ripping up of the old pavement to the finishing of the new; there being not 200 feet between the ancient and the modern. Between forty and fifty men are seen at work, the nearest barring out the old blocks, the farthest finishing up the new surface; and in between are paving cutters, block handlers, graders, concrete men, mortar bed men, block pavers, rammer and grouters. The old blocks are taken up in the usual way, with a crowbar, and are piled on the subgrade so the paving cutters can get at them handily. The cutters break and dress them, sitting alongside the piles, and replace them on the subgrade near at hand. Just behind the piles of new blocks, the grade stakes are driven, and any regulating of the subgrade that may be necessary is done; tho, as the old blocks were eight inches deep, and the new pavement, including the new blocks and the concrete foundation, is to be but eight inches deep, very little regulating is usually necessary. Then the hand-mixed concrete is placed and tamped, the dry mortar bed is spread thereon, the new blocks are carried across the prepared subgrade and thrown in the mortar bed directly back of the pavers. No sooner is the paving done than a man follows it up with a hose, flowing water thru the joints to the dry mortar bed beneath. Immediately, the first application of grout is placed in the joints, the blocks are then rammed to the best obtainable surface, thru a thick oak board, and the finishing coat of cement grout is placed. The pavement should be at once barricaded and carefully guarded by watchmen for ten days at least.

In laying the blocks on the Schenectady work, the greatest care was taken to get a true surface, and this was found a difficult thing to accomplish. After everything else had failed, a system was arrived at that gave good results. Grade stakes were driven ahead of the pavers, in a line from curb to curb, the stakes being placed about four feet apart, and lines were run from these stakes to the surface of the completed pavement just in front of the pavers. A series of bond-

NEAR *view of process of recutting the old granite blocks.*



ABOVE are diagrams of large blocks of two different sizes, showing the lines on which they are cut to make the small blocks. Below are photographs of the resulting small blocks.

stones were then placed under these lines, also spaced about four feet apart, and the pavers worked carefully to these lines and stones. Tho they thought it red tape at first, as soon as they saw the result they concluded it was worth while after all; for, as soon as the work got a fraction above grade, the line was raised from the nearest bond-stone, even if the raise in grade was so gradual as not to show on the line extending back over the completed pavement. It was the special duty of the timekeeper on this work to set these lines and watch them. The resulting pavement surface is one that, in a pneumatic tired vehicle, cannot easily be distinguished from asphalt; and, as it was laid to a straight line cross-section, a fourteen-foot straight-edge can be set up on it and turned completely around without disclosing a variance of one-half inch. The only drop from straight lines is at the gutter, where there is a grade of two inches in the last two feet. Yet, while this pavement seems absolutely smooth to ride over, it presents such a gritty granite surface that horses seem to get the best of footing, and heavy loads go up the Albany and State street grades without the least hesitation, where before it was necessary to stop for wind.

The pavement, as now laid, shows a monolithic mass, with a cross-section presenting a shade under four inches of concrete, a shade under four inches of block surface, and the difference of the eight inches made up of the mortar bed between. It might well be compared to a concrete pavement with a granite block top. The concrete foundation, in the Schenectady work, was the usual mixture of one part portland cement, three parts sand and six parts crushed stone; and the mortar bed mixture was one part cement to three parts sand. The grout in the joints was a mixture of one part cement to two parts sand, great care being taken with this. To those who visit the city of Schenectady, and want to inspect these pavements, the following will be of value:

	Sq. Yds.
Albany street, Veeder avenue to Hulett street	4,180.0
State street, Lafayette street to Veeder avenue	2,587.1
State street, approaches to Erie Canal bridge	775.4
State street, intersection of South Ferry street	42.5

State street, intersection of South Church street	1,163.8
Liberty street, approaches to Erie Canal bridge	757.1
South Center street, intersection of Veeder avenue	392.2
Nott terrace, driveway between high school buildings	205.5
Total square yards of relaid block surface	10,112.6

It would seem, from the accompanying summary of cost sheet on the State street work around Crescent Park from Lafayette street to Veeder avenue, the most nearly normal of all this work, that under proper management and supervision, any city may turn its old noisy and rough granite block pavements into the most modern form of new, reasonably quiet pavement for about $2.00 per square yard. Small yardages, at intersections and other difficult points, will, of course, cost more. The work at the intersection of State and Church, for instance, cost $2.28½ per square yard, not including extra work on curbs and sidewalks, but including a $0.27 grade and an item for watchmen of $0.18 per square yard, made necessary by the doing of the work in sections so as not to interfere with traffic, and the impossibility of barricading a street railway switching point. It will be noted from this Crescent Park work cost sheet that 77 per cent. of the $2.00 per square yard was spent in pay roll for direct city labor. Of this, $1.54 per square yard, $0.74 per square yard went to the block makers. It is cheaper, of course, to break the blocks in the Bronx way, but the result is not nearly so satisfactory, and the saving of blocks for use on other work is much less. In Schenectady, about five thousand square yards were taken up, and about ten thousand laid down with the same material.

Cost sheets in detail similar to the one given for the work around Crescent Park were prepared, the totals for four of which follow, the unit prices for labor and materials being the same as those given in the table:

The resurfacing of the intersection of State and Church streets and the portion of South Church and Water streets leading to the intersection included taking up and disposal of some old asphalt and brick pavement as well as the granite. It covered 1,163.8 square yards and was completed between Nov. 7 and Dec. 14, 1913.

Ripping up the old pavement and

LAYING the small blocks in sand cushion on concrete base. On the right mixing mortar for the grouting of the joints.

Summary of Cost Sheet—Repaving Around Crescent Park, the Albany St. Side from Lafayette St. to Veeder Ave. and the Veeder Ave. Side from Albany St. to State St.

The work consisted of taking up the granite block pavement, breaking each old 12x8x4-inch granite block into four 6x4x4-inch blocks, dressing these new small blocks, laying them in four inches of new wet 1-3-6 portland cement concrete with a thin bed of 1-3 dry portland cement grout on top, in which to bed the blocks, thoroly wetting the blocks and the mortar bed thereunder, filling the joints with a 1-2 portland cement grout and leaving a thin surplus of the grout on the surface of the pavement, and the other work incident thereto.

This work around Crescent park was done by men, excepting the block cutters and pavers, who had had little or no experience in street paving, under a foreman taken from the machine shop of the General Electric Co.; and it was performed without, at any time, blocking traffic on the street or any of the cross streets or private driveways.

This report covers the 2,587.1 square yards of work completed between September 23 and November 18, 1913.

Detail Description of Work.	Cost Total	Cost Sq. Yd.	Labor Total	Labor Sq. Yd.	Teams Total	Teams Sq. Yd.	Materials Total	Materials Sq. Yd.
Ripping Up Old Pavement, Regulating and Grading the Sub-Grade.								
Labor, ripping up asphalt and concrete...	$ 115.28	$0.0445	$ 115.28	$0.0445	.....	.....	.....	.....
Team hire, hauling asphalt and concrete...	40.27	.0156	.....	.....	$ 40.27	$0.0156	.....	.....
Labor, ripping up old granite blocks.....	78.76	.0305	78.76	.0305	.....	.....	.....	.....
Labor, regulating and grading sub-grade...	107.81	.0417	107.81	.0417	.....	.....	.....	.....
Team hire, haul. materials from sub-grade.	62.41	.0241	.....	.....	62.41	.0241	.....	.....
	$ 404.53	$0.1564						
1-3-6 Cement Concrete Foundation 4 Inches Thick.								
Labor, mixing and placing concrete fnd...	308.27	.1192	308.27	.1192	.....	.....	.....	.....
Material, cement delivered on job.....	263.35	.1018	.....	.....	.....	.....	$ 263.35	$0.1018
Material, sand delivered on job.....	71.08	.0275	.....	.....	.....	.....	71.08	.0275
Material, stone delivered on job.....	216.22	.0835	.....	.....	.....	.....	216.22	.0835
	$ 858.92	$0.3320						
1-3 Cement Mortar Bed for Blocks.								
Labor, mixing and placing mortar bed.....	190.80	.0738	190.80	.0738	.....	.....	.....	.....
Material, cement delivered on job.....	224.42	.0868	.....	.....	.....	.....	224.42	.0868
Material, sand delivered on job.....	62.80	.0242	.....	.....	.....	.....	62.80	.0242
	$ 478.02	$0.1848						
Breaking, Dressing and Laying Granite Block Surface.								
Labor, breaking and dressing granite.....	1,910 57	.7385	1,910.57	.7385	.....	.....	.....	.....
Labor, sharpening and making tools.....	129.38	.0501	129.38	.0501	.....	.....	.....	.....
Material, sharpening and dressing tools....	15.00	.0058	.....	.....	.....	.....	15.00	.0058
Team hire, shifting blocks on job.....	15.30	.0059	.....	.....	15.30	.0059	.....	.....
Labor, handling granite blocks to pavers...	102.38	.0396	102.38	.0396	.....	.....	.....	.....
Labor, paving granite blocks.....	464.77	.1796	464.77	.1796	.....	.....	.....	.....
Labor, ramming granite blocks.....	16.98	.0065	16.98	.0065	.....	.....	.....	.....
	$2,654.38	$1.0260						
1-2 Cement Grout Joints and Surface.								
Labor, mixing and placing cement grout...	120.66	.0466	120.66	.0466	.....	.....	.....	.....
Material, cement delivered on job.....	182.85	.0707	.....	.....	.....	.....	182.85	.0707
Material, sand delivered on job.....	27.55	.0106	.....	.....	.....	.....	27.55	.0106
	$ 331.06	$0.1279						
Overhead Charges.								
Labor, foreman, assistant foreman, etc....	211.94	.0819	211.94	.0819	.....	.....	.....	.....
Labor, watchman	142.87	.0552	142.87	.0552	.....	.....	.....	.....
	$ 354.81	$0.1371						
Extra Work.								
Repairs to curbs, sidewalks, sewers, etc...	111.18	.0430	111.18	.0430	.....	.....	.....	.....
Total	$5,192.90	$2.0072	$4,347.96	$1.5507	$117.98	$0.0456	$1,063.27	$0.4109

The prices paid for labor and material for this work were as follows, labor being per day of eight hours:

Foremen	$ 4.00	Horse, wagon and driver	4.00
Assistant foremen	3.50	Portland cement, bbl. f.o.b. cars	1.24
Granite block cutters	5.00	Sand, ton f.o.b. bank	.25
Granite block pavers	5.00	Crushed stone, 1½-inch, ton f.o.b. job	1.75
Laborers and watchmen	2.25	Crushed stone, ¾-inch, ton f.o.b. sidetrack	1.30
Teams, wagon and driver	5.00		

disposing of it cost $312.55, or $0.2686 a sq. yd.

Concrete foundation, 1:3:6, 4 inches thick, cost $298.29, or $0.2563 a sq. yd.

Cement mortar bed for blocks, 1:3, cost $242.43, or $0.2083 a sq. yd.

Breaking, dressing and laying the granite block surface cost $1,375.36, or $1.1818 a sq. yd.

Cement grouting joints and surface, 1:2, cost $158.48, or $0.1361 a sq. yd.

Overhead charges were $272.68, or $0.2343 a sq. yd.

Extra work cost $183.32, or $0.1575 a sq. yd.

THE *completed granite block pavement with grout surface is as smooth as asphalt. The court house on the right makes less complaint of the noise, which was quite unbearable with the old pavement.*

The total cost was $2.843.11, or $2.4429 a sq. yd.

Separating this into labor and material costs, the total cost of labor on the job was $2,289.19, or $1.9670 a sq. yd., which is 80 per cent. of the total cost.

Teams cost $174.16, or $0.1496 a sq. yd.

Materials cost $379.76, or $0.3263 a sq. yd.

Resurfacing of State street between Wall street and the canal bridge and 142.8 feet of Dock street south from State street, except raailway track, covered 575.5 square yards, done between Nov. 3 and Dec. 17, 1913.

Grading cost $104.54, or $0.1816 a sq. yd.

Four-inch concrete foundation, 1:3:6, cost $148.16, or $0.2576 a sq. yd.

Mortar bed for blocks, 1:3, cost $91.67, or $0.1593 a sq. yd.

Breaking, dressing and laying granite block surface cost $700.20, or $1.2168 a sq. yd.

Cement grout joints and surface, 1:2, cost $60.82, or $0.1057 a sq. yd.

Overhead charges were $74.34, or $0.1292 a sq. yd.

Extra work cost $35.11, or $0.0610 a sq. yd.

The total cost was $1,214.84, or $2.112 a sq. yd.

If the cost is analyzed as to labor and material costs the showing is as follows:

Labor, $1,101.25, or $1.7574 a sq. yd., which is 83 per cent. of the total cost of the pavement.

Teams cost $28.16, or $0.0488 a sq. yd.

Materials cost $175.43, or $0.3050 a sq. yd.

Resurfacing of approaches to canal bridge on Liberty street leading into Liberty street and of 924 feet of College street leading into Liberty street, including removing and disposing of old asphalt wearing surface and taking up and relaying granite block wearing surface as described in the Crescent Park table covered 757.1 square yards, done between Nov. 6 and Dec. 4, 1913.

Ripping up the old pavement and regulating and grading subgrade cost $181.47, or $0.2397 a sq. yd.

Concrete foundation, 1:3:6, cost $175.01, or $0.2311 a sq. yd. The old concrete was crushed and used as stone in the new concrete.

Mortar bed for blocks, 1:3, cost $167.13, or $0.2208 a sq. yd.

Breaking, dressing and laying granite block surface cost $862.38, or $1.1391 a sq. yd.

Cement grout joints and surface, 1:2, cost $90.35, or $0.1193 a sq. yd.

Overhead charges were $83.87, or $0.1107 a sq. yd.

Extra work cost $53.54, or $0.0707 a sq. yd.

The total cost was $1,613.75, or $2.1314 a sq. yd.

If the cost is classified as labor and materials the results are as follows:

Labor cost $1,298.43, or $1.7149 a sq. yd., which is 80 per cent. of the total cost.

Teams cost $79.75, or $0.1053 a sq. yd.

Materials cost $235.57, or $0.3112 a sq. yd.

The resurfacing of Albany street between Veeder avenue and Hulett street, except the railway tracks, is the earliest work of the kind, being done between June 2 and Oct. 29, 1913. It covers 4,189 sq. yds. The work is also somewhat different from that of the others, consisting of removing and disposing of the old asphalt block wearing surface, repairing and adjusting the old concrete foundation, recutting old 4 by 8 by 12-inch granite blocks from Lower State street to 4 by 4 by 6-inch new granite blocks, dressing same and laying them in 1:4 portland cement mortar bed with 1:2 portland cement grout and surface plaster.

The grading and removing of old materials cost $507.84, or $0.1212 a sq. yd.

Patching the old concrete base cost $185.65, or $0.0443 a sq. yd. This is not the cost per square yard of concrete patch but the total cost of the patching of foundation divided by the number of square yards of completed pavement, and the sand in the old cushion for the asphalt blocks was used for making concrete and mortar bed. Concrete 1:3:6.

The mortar bed for blocks, 1:4, cost $851.36, or $0.2033 a sq. yd. It was laid much thicker in some places than others, the old concrete surface being very uneven and requiring a mortar bed 1 to 4 inches deep to bring it to uniform surface.

Breaking, dressing and laying the granite block surface cost $4,330.63, or $1.0339 a sq. yd., the blocks in the yard, hauled there by contractors with a few by the city from other streets, being cut and used. The block laying is so evenly done by the pavers that the only ramming is done by the men grouting the joints when this shows high blocks.

Grout joints and surface, 1:2, cost $621.19, or $0.1483 a sq. yd.

Overhead charges were $649.76, or $0.1550 a sq. yd.

Extra work cost $26.07, or $0.0062 a sq. yd.

The total cost was $7,172.52, or $1.7122 a sq. yd. Excepting the block cutters and pavers, the men on this job never had worked on street paving and were under a foreman taken from the machine shop of the General Electric Company. There was no blocking of traffic on the street or on any of the cross streets or private driveways.

Classified under labor and materials the costs show as follows:

Labor cost $5,756.61, or $1.3743 a sq. yd., being 80 per cent of the total cost.

Teams cost $386.48, or $0.0922 a sq. yd.

Materials cost $1,029.43, or $0.2457 a sq. yd.

John Hickey was the superintendent of streets and Robert K. Wilson was general foreman of street repairs, under Charles A. Mullen, commissioner of public works.

The Small Consumer and the Central Electric Station.

By S. E. Doane, Engineer, National Lamp Works.

This rather neglected and despised class of customers of American light and power companies is cultivated to their financial advantage by European electricity and gas producing companies and an expert gives herewith the results of a careful study of the foreign methods, as outlined before the Wisconsin Electric Association.

A YEAR and a half ago, the time having come when it seemed to us wise to spend a little time on the question of the small customer, I sent one of my assistants to Europe, where the small customer business is cultivated, and followed myself some months later. Mr. Eisenmenger began his work in August, 1912, by sending out circular letters to 660 central stations, from which he received 300 replies. Two hundred of these replies indicated that the central stations were more or less actively going after the business of the small customer. To cut a long story short, Mr. Eisenmenger investigated such of these as he apparently was most interested in and joined me in the south of Europe in March, 1913, and we together spent two months just touching the high spots. The result of our work, which occupied about a year, is embodied in a report of ninety typewritten pages which he have handed to the National Electric Light Association.

In one large European city the entire service is on meters, but every care has been taken to embody best practice. The meters are cheap. The distribution system is well loaded by intensive business cultivation, and, tho the rates are not low, the income from individual customers is extremely low because of the customers' small size. This central station stated that it obtains an average return from its city territory of 70,000 population and on adjoining country district of about the same, of almost $9 per small customer per year, whereas the minimum return for any customer per year was $4.50. This was a private company and its balance sheet apparently shows a healthy financial condition and 11 per cent dividends for the year 1912.

In another case, covering very different practice, one city of about 650,000 people, where the private plant was in competition with the municipal plant, the private plant had about 40,000 meter customers and about 25,000 customers on limiting devices. The city plant has about 24,000 customers on limiting devices (I have no record of the customers on meters of the municipal lines), making a total for the city of over 90,000 customers. This, as you will notice, is one customer for less than seven people. It certainly is an intensive development.

Speaking now of the private company, who extended to us every courtesy and facility for investigating their 25,000 customers on limiting devices, it has an average connected load of 21.7 watts. Their rates cover everything from a single 10-watt lamp upwards. This single 10-watt lamp is supplied for 16 cents per month, including wiring rental. They did not think they made money on this customer, but are very sure that if the customer paid 25 cents a month he would be profitable.

The various schemes I am about to mention are more generally applicable to small customers on limiting devices than to small customers on meters. The practices can be treated under five heads: Soliciting, installing, billing and collecting, metering or its equivalent, relations with contractors.

As a general thing the advertising so-

licitation is addressed to the small customer on the theory, which seems to have worked out, that the housewife, whom they figure they must address, will insist on electric light being installed in her home if her poorer neighbor has it, whereas the reverse is not true, so that solicitation addressed to the smaller customer reaches the larger customer automatically. The obverse of this does not hold. This advertising is cleverly done and is fully up to our standards. They have in Germany a Co-operative Electrical Development Association in full operation.

We find that the customer's installation is often financed in some manner. They have several ways of doing this, but they all have the same purpose, which is to relieve the customer of the comparatively large expenditure necessary to wire his building. Collections are made periodically in small installments, with a sufficient additional amount to pay interest on the money thus invested.

The billing and collecting schemes are ingenious. I think the most ingenious is a scheme in use in several places, of making out a card with a number of coupons attached, once a year, and handing this card with the coupons attached to the collector and billing the collector at each period for the total amount charged to his account. Twelve of these coupons are attached if collection is to be made once a month, four if to be made once a quarter, etc. At the period named the collector exchanges a coupon for the cash. The collectors in many cases work without commission. This is equivalent to our corner drug store agreeing to collect for his neighborhood, as is sometimes practiced in this country. You will note that this practically almost entirely eliminates the cost of billing and collecting.

It is generally recognized in Europe that the cost of a small customer, with normal use of lighting, is over 90 per cent fixed, and, consequently, it is more equitable to charge him a flat rate than it is to charge him a rate which varies with the kilo-watt hour component of its cost. In case it is decided to charge a customer a flat rate, there are then two problems. The first one is how to prevent him from using a greater amount of electricity at any one time than would be normal for his contract. The second one is to prevent his using electricity for more hours than would be normal under his contract.

The first condition is very often met, in fact, invariably, so far as our information goes, by a circuit breaker of neat, compact appearance and low first cost, which opens the circuit when the load thereon exceeds the rating of the instrument. This circuit is restored, then broken again, etc. I think that we are all familiar with this practice, but development over there is proceeding along such lines that they say in general the cost of the device does not exceed $1.50.

The question of lamp efficiencies also comes in here, as the central station, in order to carry the largest number of customers possible on its investment, must have the smallest possible maximum demand from each. Very high efficiency lamps are used, and, in consequence of these high efficiency lamps, high efficiency reflectors and not too high intensity, the average small customer in the illustration I have chosen gets along with 1.8 lamps connected and with an average connected load of 21.7 watts.

To guard against the second danger, that of a customer operating his installation too many hours, the customer is made to buy his own lamps. The life of this lamp is short, about 500 hours, we are informed, so that the customer from time to time buys a new lamps and understands that the more hours he burns his lamps each night the greater will be his lamp renewal cost, which, of course, is not negligible to the man of small means.

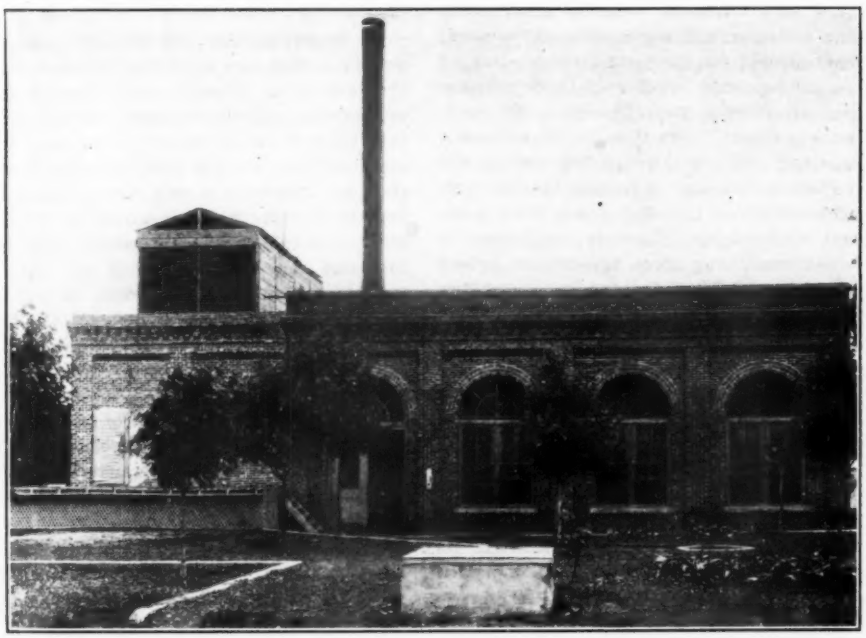
In practically every city we noted that the contractors and central stations are working in harmony. There is usually the finest kind of co-operative effort. The contractor secures in some cases financial assistance in the purchase of his supplies. The central station points out that, inasmuch as they expect to finance their customer at any event, they only have to carry this financial load a few days more if they finance the contractor also.

A MUNICIPAL ICE PLANT

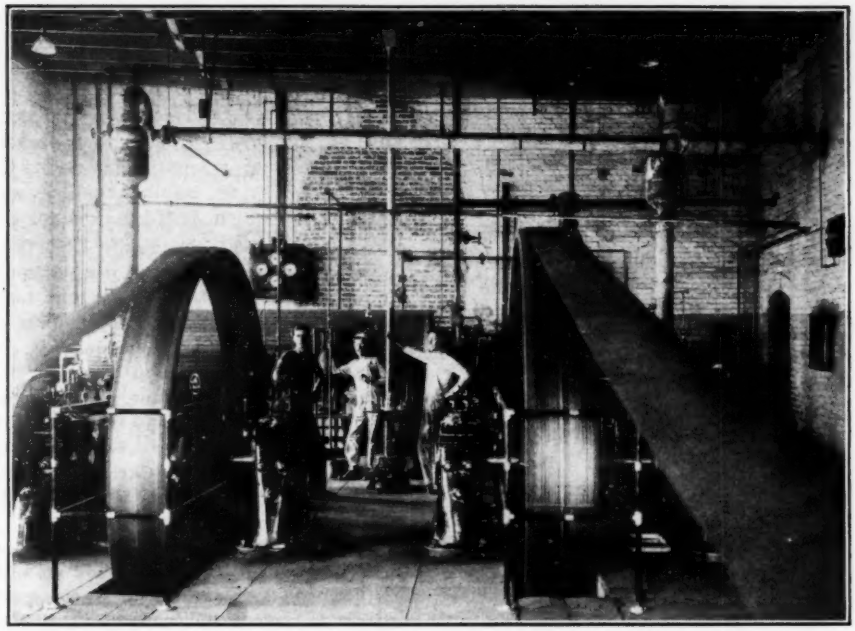
The manufacture of ice as a practical by-product of an electric light plant which has but little load on it during the day has been advocated for several years and has been applied with more or less success in some small private plants. This is the first successful municipal ice plant, largely because previous efforts in some states have been stopped by the courts on the ground that municipal ice making was not specifically permitted by the statutes.

AN exhaustive report has recently been made to the President of the Borough of Manhattan on municipal and government ice plants. From this it appears that, while the latter has operated a highly remunerative plant at Manila, even after reducing the price 25 per cent., another at Panama, as well as several in the department buildings in Washington, the City of Weatherford, Okla., is the only municipality operating its own ice plant. It showed, however, that a great interest was being taken in the matter and that cities in over a dozen states were considering the question. With the spread of the home rule idea and the commission form of government, it is probable that there will be many more such municipal ice plants in the near future. There is no real reason why a city which can distribute and sell water in its liquid form should not sell it in the solid state. Legislatures may have to enact new laws, but the municipal ice plant is coming.

Ice is as much a public necessity as



THE *electric light plant at Weatherford, Okla. The new ice plant is in the new addition at the left.*



INTERIOR *of engine room of electric light plant at Weatherford, Okla. The ice-making equipment is in the rear of the room where the men are standing.*

electric light and water. Weatherford largely owes its successful ice plant to its commission form of government and to the sagacity and untiring energy of its commissioner of public works, Mr. Hugh J. Cooper. Weatherford is a city of about 2,500 inhabitants and is fortunate to have such a live wire in its service. If the Dayton idea spreads of appointing general managers to run cities on a business basis, Weatherford may lose Mr. Cooper to some larger municipality.

Weatherford had voted a bond issue of $9,000 for a City Hall. Before this was built, however, the commission form of government was adopted and Mr. Cooper and his associates rightly decided that to build it would only add unnecessary salaries and expense to the community. The city was operating its own water and light plant, but was getting its supply of ice from outside sources at high prices, with very considerable shrinkage and irregularity. When most needed it was not to be had.

After an active campaign in the spring and summer of 1912, the voters upheld Mr. Cooper's suggestion to use the City Hall fund for a municipal ice plant. In November a contract was closed with the Carbondale Machine Company, of Chicago, Ill., for one of their ten-ton exhaust-steam ice plants of the atmospheric type.

In this system, ammonia gas is driven off of aqua ammonia and condensed by steam heat in the generator coils. The only moving part about the system is a small pump corresponding to a boiler-feed pump requiring hardly more than a tenth of a horse-power per ton of ice capacity. As exhaust steam at three pounds pressure from the electric light engines and pumps is used in the generator coils and as the city water supply is first used for condensing purposes in the ice plant without extra pumping, ice is made practically as a by-product. When running full capacity, Mr. Cooper says the total operating cost of making a ton of ice is not more than 50 cents, of which 10 cents is for fuel and 40 cents for labor. During the spring and fall,

when the capacity is reduced, the cost runs higher than this.

One of the accompanying photographs shows the interior of the engine room with the generator of the ice machine in the background. This, with the small aqua pump, receiver and exchanger, are the only parts in the engine room. As the generator itself can be placed on a platform out of the way if necessary, the extra floor space required is merely nominal. The atmospheric parts of the machine, including the absorbers, condensers, rectifier and weak liquor cooler, are placed on the roof of the new tank building.

Another photograph shows the interior of this tank building. The new tank house is 20 feet by 54 feet 9 inches. The machinery and building represent an expenditure of $11,000. This is about $2,000 more than the cost of installing an electrically driven compression machine, but Mr. Cooper wisely decided on low operating cost instead of low first cost. Figuring current at 2 cents per k.w. hr., the power cost per ton would have been at least $1.25, as against 10 cents fuel cost in the Carbondale machine. The saving in operating cost will very soon make up the difference in first cost.

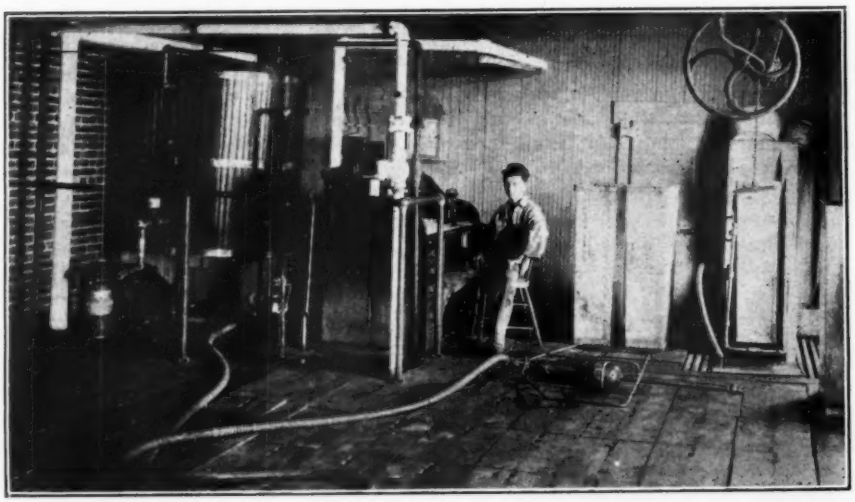
The plant was started in April, 1913, and on January 1, 1914, their report shows ice sales amounting to $4,628.55. The total cost of making the ice was $2,137.19, of which $1,103.70 was for delivery and $1,033.49 all other expenses.

The ice is sold direct to the citizens. The prices, delivered, are: Less than 1,000 pounds, 40 cents per 100; 1,000 pounds or more, in full blocks on one delivery, 30 cents per 100. Prices on the platform are: Less than 300 pounds, 40 cents per 100; 300 pounds to 1,000 pounds, full blocks, 25 cents per 100; 1,000 pounds or more, 20 cents per 100. Carloads, f. o. b. municipal siding, 15 cents per 100, or $3 per ton.

Perhaps other municipalities having light and water plants can form an idea of the probable ice sales by Mr. Cooper's annual report. This shows the following receipts:

Water sales, $4,108.96
Electric current sales, $8,499.90.
Ice sales, $4,628.55.

He reports that the cost of operating the water and light plant just about equals the receipts, but the ice plant shows a handsome profit. It is probable



THE interior of the tank room of the new ice plant in connection with the Weatherford, Okla., electric lighting plant. Under each cover with hand-hold is a can in which a cake of ice is being frozen.

that in 1914 the tonnage may be materially increased by taking outside contracts, for they are in a better position to tell just how much surplus they will have over and above their local needs.

In addition to the direct profit there was an indirect profit to the citizens of at least $1,200, due to the reduction in cost of ice. Then full weights were given instead of those reduced by shrinkage.

The value of this plant to the municipality could be still further increased by the addition of several well-insulated cold storage rooms. Such small cold storage rooms do not pay in the independent plant when the machine has to be operated solely for same. But with by-product refrigeration, the operating cost is practically nil. Local eggs could be stored in April for the fall and winter, meats could be brought in by the carload and kept until needed.

MUNICIPAL AND GOVERNMENT ICE PLANTS

In connection with the above paper on the ice plant at Weatherford, Okla., some items from a report on municipal and government ice plants in the United States and other countries made to the president of the Boro of Manhattan, New York City, will be of interest. This report was prepared by Jeanie Wills Wentworth, and contains the available information upon this subject.

Weatherford is the first city actually to enter upon the successful manufacture and sale of ice, tho several attempts have been made to provide ice thru municipal officials. Schenectady, N. Y., is, perhaps, the most noted of these. A supply of ice was cut from the river and stored for delivery by gift or sale at cost, and the distribution was begun at a price well below that charged by local ice companies. This distribution was prevented by an injunction granted on the ground that the city had no authority under its charter to make and sell ice. The same decision has been made in cases arising at Mt. Vernon, N. Y., and Lewiston, Me.

Camilla, Ga., has obtained a favorable decision from the Supreme Court on the question of its right to establish a municipal ice plant, but has not yet availed itself of the privilege on account of lack of funds. Ruston, La., received a favorable decision on the same question from the lower court, and the question is now before the Supreme Court.

Cities in Minnesota, Missouri, Michigan, Ohio, Oklahoma, Oregon (probably), Wisconsin, Connecticut, Colorado, and California can construct ice plants either under special acts or general charter laws.

Plants for artificial or natural ice are proposed and funds have been provided in Fernandina, Fla.; Willimantic, Conn.; New Britain, Conn., the two latter being natural ice storage plants recently put in use.

A number of other cities are agitating the question, results in some being delayed by lack of legislation, in others by lack of funds, and in still others by the successful opposition of local business interests.

The United States Government has a number of plants in operation for the supply of its own needs in Washington, D. C., in four buildings; one in Manila, Philippine Islands, which sells to government employes also, and at the local market price to others, but not delivered, so as not to compete with the local manufacturers; in Panama; and is constructing a plant at Pearl Harbor, Hawaii. Details of cost and production in these plants are given in the report.

In the cities in the hot and the dry regions in the United States, and in all cities during the summer, ice is a necessity rather than a luxury under modern city conditions, and should be sold at the lowest possible price to those unable otherwise to obtain it.

BITUMINOUS ROAD CONSTRUCTION

A REPORT OF ENGLISH EXPERIENCE

By Francis Wood, Boro Engineer and Surveyor, Fulham, England.

England has studied and experimented with the use of bituminous binders in the construction of roads more extensively than the United States and has more years of experience behind her. This report of their practice, which received the prize of the International Road Congress, will therefore be read with interest, especially as the intensive traffic which follows the completion of adequate roads is showing the certainty of development in this country just as it has in England.

IN considering the methods that should be adopted in road construction to satisfy the various classes of traffic, it is desirable that a close and careful investigation should be made into the various forces that are brought to bear on the road, and the reason for the failure or success of the present methods.

Generally speaking, waterbound macadam is the form of construction that fails to respond satisfactorily to the new forces. For many years this method has been employed successfully, and it probably would have continued if it had not been that the new types of traffic quickly developed or exposed its real and inherent weakness. This weakness of the macadam road cannot be set down deliberately to the form of construction which has been so universally employed for many decades. It is entirely due to the fact that moisture is employed in the construction as an agent for binding the particles together, whereas moisture has no real binding qualities whatever. When an old macadam road has its surface in an almost dry condition, it is very dense and gives an excellent road surface, but if the moisture in the construction is at all in excess, or if there should not be quite sufficient moisture to enable the particles to be retained in their position, then the road begins to fail, and, if the traffic is considerable, the failure is, comparatively speaking, very rapid.

One is therefore led to the conclusion that, although the material that is used to make up the structure may itself and individually be satisfactory as a wearing substance, there is, when it is an unstable mass, so much interior attrition, abrasion and disintegration, due in a very considerable degree to certain atmospheric conditions, that, as a whole, the construction may be regarded as quite unsatisfactory, especially where the traffic is of such a character as will emphasize its weakness.

If we take other examples of roads, we find illustrations demonstrating by inversion the position taken up, viz., that weather is the principal factor in the destruction of the macadam road, e. g., a rail on a railroad will be found to wear in an almost exact proportion to the tonnage which passes over the rail.

Similarly, granite sett paving wears proportionately to the amount of traffic; it is true that the edges are rapidly broken and rounded, but if the paving was made close jointed there would be found to be very little wear, except in the manner which has been suggested, and, of course, depending on the quality of the stone.

Wood paving wears proportionately to the traffic, but, as wood paving is of varying consistency, due to the fact that the heartwood and the sapwood are hard and soft respectively, we have, after a

period of time and where there is considerable traffic, a series of small depressions which make the surface somewhat uneven; probably a more careful selection of timber with a regular grain thruout the full width of the block would give the even surface which is desired.

Horse traffic will deteriorate the water-bound macadam road more rapidly than motor traffic, if the latter is traveling at the same rate as the former, because the force that is brought by the horse's foot is much greater than is warranted by the load the horse is pulling; the frictional resistance is greater, because it is confined to the point of a toe, whereas in a motor vehicle the resistance is spread over a much larger area, *i. e.*, the area of the driving wheel in contact with the surface of the road.

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¶ THE SPEED *of the motor vehicle offsets the advantages of tire traffic over horseshoe traffic, and more.*

From these remarks, one might be led to expect that the motor vehicle would have a less wearing effect on the road than horse traffic, and this would actually be the case if the speed of the motor was no greater than the speed of the horse, and the load was similarly proportioned, but we have to recognize that the speed of the motor propelled vehicle is from two to four times that of the horsed vehicle, and, as the kinetic energy of the vehicle increases as the square of the velocity, it follows that the conditions must always be different. For example, if the horse travels at an average rate of four miles per hour with a heavy load, and a similarly loaded mechanically propelled vehicle travels at twelve miles per hour, the kinetic energy of the latter is nine times that of the former. This increased kinetic energy would not affect adversely the ideal resilient roadway, and it is shown by the remarkable change from horsed vehicles to motor vehicles in the great cities that the wood paved, asphalt and granite set paved roads are not very seriously affected. It may even be the case that the decrease in the quantity of manure collected from the streets is a compensating factor for any increase in the cost of the maintenance due to whatever increased wear there may be due to the altered form of traffic.

On the other hand, if there should be any depression, however slight, this depression extends in a very rapid manner, and there is found a second depression a little further along; from this a third depression is made, and so it continues. This is due to the jumping of the vehicle out of the first depression, the place to which each jump extends being subjected to a much greater force than would be the case if the surface had been even. Therefore, as soon as one depression is observed in the roadway, it should be remedied at once, otherwise, not only will there be material wear, but the foundations may give way, and the repair be a more serious item than would otherwise have been necessary.

It follows, therefore, that roads will have to be regularly and carefully watched by experienced men, very much in the same way that plate layers on a railway are continually attending to the rails, and looking out for any unevenness that may arise or that is likely to do so.

Vehicles are usually fitted with springs, and it may be proved to be the case that the swaying of the body will cause weight to be transferred to the wheels in excess of the weight when the vehicle is in a standing condition; thus, any calculations that may be based on the normal or standing conditions of a vehicle may be rendered useless.

It is due to these factors that a road is being subjected to different conditions, even when the same type of vehicle is traversing the road.

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¶ OTHER *exterior forces of importance in their effect on roads are constant, whether there is traffic or not.*

These may be termed the exterior forces, but there are exterior forces which affect the interior of the structure, viz., the changes of temperature, and atmospheric influences. We have seen that, as a consequence of the atmosphere absorb-

ing moisture from the waterbound road the road rapidly ravels. There is, however, another phase when the atmosphere deposits moisture by condensation on the surface of the tar and bituminously constructed road. This moisture being continually beaten into the surface of the road, and not being in sufficient quantity to run off into the channels, is a disintegrating force, for the reason that in tar there are naphthaline and free carbon, which are materials having a great affinity for moisture, and there are bitumens which are fluxed with oils which are in some degree capable of emulsification. The bitumen, if it has been fluxed with a large quantity of oil, or if it be bitumen from a residual of oil, will be deteriorated more rapidly than would be the case if a natural bitumen was used, requiring only a small quantity of fluxing oils. This factor is one that requires careful consideration; if the road is examined and watched in the late autumn, when the temperature is low and the atmosphere heavy with moisture, the effects may be easily seen. The fact also that in low temperatures the adhesive and flexible qualities are much less than at higher temperatures assists in the deterioration. Where the traffic is not so marked, it may be almost ignored. Hence, one is led to conclude that tar is, from its composition, a material not suited to heavy or even continuous light traffic, and that any bitumen that is used should be of a very stable and consistent character, and should be fluxed with the least quantity of emulsifying oils compatible with the requisite standard of viscosity or flexibility that the nature and composition of the pavement demands.

¶ TAR PAVEMENTS *are satisfactory under the conditions stated here.*

It is recognized that under certain favorable conditions tar pavements are satisfactory. Those conditions are (1) light traffic, not too continuous, and (2) fine or dry weather. But a tar concrete can be made, which, if it is composed of a conglomerate, *i. e.*, stone broken to one and one-half inches, together with fine material, will withstand heavy vertical pressure, and, if the light oils are eliminated from the tar and only the heavy oils used with pitch (about 25 per cent. of the former with 75 per cent of the latter) or a carefully prepared tar mixture giving approximately the same consistency, a very strong tar concrete can be made which also may be reasonably flexible in cold weather and not too soft in hot weather; and, what is more important, it can be mixed and laid the same day.

Thus, the old macadam and a proportion of the fine material in the road to be resurfaced may be removed, roughly screened, heated so that all the moisture is eliminated, and immediately, and before the material is cold, the stone and fine material can be treated with the tar mixture and relaid in the road to a depth of about two and one-half inches, the section of which should give a very dense appearance. In this way the road foundation should not cost more than one shilling per superficial yard.

On the top of this composition, a bituminous composition should be laid, the thickness depending on the traffic; in no case, except by-streets, should it be less than one inch; where heavy traffic is the rule then the thickness should be increased to one and one-half inches.

¶ THE QUALITY *of bitumen to be used is carefully and fully described.*

The bitumen to be used should be of such a character that it has recuperative powers; it should be adhesive and ductile; the viscosity should be observable at 32 degrees Fah., and it should not flow at 120 degrees Fah. Up to the present time the only bitumens that have these characteristics are given in general terms. It is, perhaps, not advisable in a paper of this nature to specify any individual bitumen, as it is possible that composite bitumens could be made to fulfill the conditions, or have such other advantages as to give favorable results. It is perhaps necessary to define or explain the reasons for the conditions. Recuperative power is necessary because, if a depression is made in the composition,

and the bitumen has no capacity for recovery, the depression remains in the composition and will be a source of weakness, first, from the fact that it will retain moisture, which is a deteriorating factor for all bituminous compositions, and, secondly, because the depressions will increase in size, and the traffic has a tendency to increase them in number, as has already been explained. Also, if the material will not recover itself, every disturbance of the composition by frictional resistance, especially where a vehicle starts on its journey, will develop, and the material will show marked wearing effect. Adhesiveness is necessary without explanation, and similarly ductility is a self-evident requisite. The viscosity at low temperature is necessary because it indicates the ductility of the material, and if it has not a flowing point at 120 degrees Fah., it may be anticipated that little trouble will be experienced in the hot summer temperatures. If the bitumen has a high viscosity at high temperatures, less bitumen is required in the composition; if, on the other hand, the viscosity is low at high temperatures, it follows that an increased quantity of bitumen is required. It may therefore be found that an expensive bitumen is cheapest in the manufacture of a composition, and no comparison should therefore be made of the cost of bitumens, but in the quantities that are necessary to make the satisfactory road composition.

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¶ BOTH *summer and winter conditions must be taken into account in preparing the bitumen for a pavement.*

The composition above described would be made up probably with local sand, the percentage of bitumen being dependent on the quality, the viscosity, and the district and atmospheric conditions to which the material is to be subjected, but the amount may vary from 12 per cent. to 18 per cent., and even a higher percentage may be necessary.

Hot weather on asphalt or bituminous compositions softens the bitumen in the mixture, especially if it has a high viscosity at high atmospheric temperatures, and is in excess. The percentage of bitumen must be sufficient to properly maintain the particles together in the winter, *i. e.*, at the time of greatest contraction. It must be a carefully selected quantity, and the viscosity of the bitumen must be so tempered that it is not too soft in the summer conditions, because the tendency of the traffic is to force the top layer, which is hottest, out of its original position, and in this manner a waviness is produced which will increase and form an objectionable surface.

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¶ ARTIFICIAL *bituminous mixtures are more suitable for road construction than the natural rock asphalts obtainable in England.*

The synthetic mixtures are perhaps more suited to the new traffic conditions than the natural rock asphalts, which are in a somewhat unalterable condition, *i. e.*, as regards the bitumen. But there is no doubt that a careful inquiry into the composition of various rocks can be made, and a mixture obtained that would satisfy even the new conditions of traffic which are causing such serious displacements and to such an extent that the material is being condemned. Probably it will be found that instead of cement concrete for the foundation, a bituminous or tar concrete will be found to be effective in minimizing the creeping of rock asphalt, as then the asphalt and concrete would form part of the surface structure and thus prevent the sliding over the surface which occurs where the mixture is laid on a smooth cement concrete, to which rock asphalt makes no adhesion.

The difficulties in connection with tar macadam construction are similar to those in asphalte and bituminous compositions not properly made. The tar, having a low melting point, flows in hot weather, or is so soft that it loses both its ductility and its adhesiveness, and the traffic easily moves the stones about. Then, as the tar volatilizes, it becomes hard and brittle, and, although it may have ductility and adhesiveness in summer temperatures, both ductility and ad-

hesiveness disappear in cold weather, and if the traffic is at all severe it breaks up or crumbles.

Volatilization also occurs where the tar is used in a plastic condition when cold, as, for example, it is in the case of the pitch grout systems, but in a degree dependent on the oils used. The pitch eventually becomes hard, is slippery, non-resilient, and has a tendency to crumble. The repair with the same material is not very satisfactory. This system, if applied in the road as a foundation for the bituminous surface coating would probably be satisfactory, although it is inclined to have too little resiliency.

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¶ ASPHALT MACADAM *by the mixing method is a standard in England.*

Another form of paving is called "asphalt macadam," and is, in principle, the method employed in ordinary water-bound macadam construction, but bitumen takes the place of moisture. This composition has been found to be satisfactory, and it is composed of thoroly heated stone, cubically broken to one and one-half inches, about 50 per cent. to 60 per cent., fine sand 20 per cent. to 25 per cent., and bitumen and fine dust about 15 per cent. Each portion is accurately and definitely measured, the bitumen being kept to a uniform standard. It is laid in a hot condition about three inches thick, and the surface grouted with bitumen. The surface grout itself will last at least two years, under heavy traffic. As the traffic keeps to the center of the roadway, the only part affected is the center half, and thus, if the worn area of the squeegee coat of bitumen is replaced, the road can be made to last an indefinite time, the cost of such squeegee coat being about 2d. (4 cents) per super yard actually covered. The difficulty has been to find a bitumen that can be squeegeed on to the surface. One method, however, is to spray the surface with a volatile oil so as to thoroly clean the dirt and dust from the existing surface, then the hot bitumen will make a good contact and not roll or peel off. Another method is to flux the bitumen with a light oil, and with this composition secure adhesion.

The objection to the latter is that it takes some time for the light oil to volatilize, and in hot weather the surface is soft and somewhat easily affected by the traffic; if, however, this inconvenience can be tolerated for a few days, the surface will become satisfactory.

The reason for this suggestion is due to the careful calculations that have been made that the traffic wear is at a rate of something between one and two millimeters per hundred tons of traffic per foot of width of road. Probably, on a rock asphalt pavement, it is even less than this rate, so that the wear is confined to the squeegee coat if it is placed on a satisfactory under-structure.

Another composition would be to mix about 60 per cent. bitumen and 40 per cent. of tar of a similar consistency to the bitumen with the material above mentioned. In this manner the bituminous portion of the composition is cheapened, and the preparation may be used in a similar manner as described above with every prospect of success. The material laid by the writer would indicate that the tar and the bitumen are improved by the mixture. The mixing of the tar and the bitumen has to be carefully made, a soft pitch (melting point 150 degrees Fah.) is fluxed with creosote oil so as to bring the specific gravity of the combination to 1.27. The bitumen is similarly fluxed to the same specific gravity, and when they are in a similar condition the mixture is made, the surface of both materials being free from bubbles when at a temperature of about 300 degrees Fah. The mixture should not be kept too long over a fire, as the consistency rapidly alters in composition at this high temperature.

The rolling of hot mixtures is a factor which must not be overlooked; too great a compression by over-rolling is likely to be detrimental because it removes the voids or spaces which are necessary for the bitumen to carry out its work. It should therefore be the case that the roller should not have a greater capacity than 20 to 25 cwt. per foot of width of the roll. The material would be bene-

fited not only by rolling in the direction of the length of the road, but also by rolling across the width of the road, so that the stones are brought into contact with the bituminized particles from every direction. The hotter the weather the less should the mixture be rolled. All that is required is that the composition should be homogeneous, or rather, that all the particles should be in proper contact, and then the traffic allowed to do the rest of the work of consolidation and compression.

For less heavily trafficked roads, a tar concrete instead of bituminous concrete could be used, and instead of a squeegee coat of tar a squeegee coat of bitumen should be used to make up the surface; this form of construction is only applicable to the roads where light traffic prevails, as the squeegee coat could not save the tar concrete from being deteriorated by heavy traffic.

Thus a bitumized road is resilient, can be constructed to suit heavy traffic or light traffic, and its cost can be proportionate to the traffic which is placed upon it. Further, its maintenance will also be proportionate to the traffic upon it.

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¶ TAR-COATED ROADS *are good for certain kinds and amounts of traffic.*

From a careful examination of tar-painted roads, there is evidence to justify an experiment of considerable importance. During hot and dry weather the tar-coated macadam road, if the coating does not become worn thru to the macadam, presents an excellent resilient surface; its defect is that in the autumn and winter the cold and wet weather deteriorate its resilience to such an extent as to break it up, and, with heavy traffic, cause an objectionable mud to form on the surface. The writer made, about five years ago, an experiment of laying ordinary mastic asphalt about three-fourths of an inch thick on the surface of a macadam road; this section was laid where the traffic was very light, but no adverse effects from the weather have been noticed. The disadvantage of the process was that a considerable amount of labor was involved in laying the material, and the area covered was very small per day. An endeavor has been made to deal with it on a larger scale and to use a synthetic mixture.

The various kinds of mixtures that are possible by using different consistencies of bitumen are interesting, *e. g.*, if an aggregate is taken and the bitumen fluxed so as to be very soft, a small percentage of bitumen only is necessary, as has already been stated, and a much larger percentage of bitumen may be used more advantageously if it is fluxed, so as to have a low melting point. But there is a point when the softness of the bitumen is of great importance, as if it is too low the composition is very hard and brittle; if too soft, then in hot weather there is a tendency for the composition to be so soft as to allow the traffic to make depressions in the surface—altho the bitumen will not run, the traffic finds the surface very heavy.

These experiments were made with the idea of obtaining a very flexible material, somewhat similar to the summer condition of tar coating, and of such a thickness that it would last satisfactorily on the surface of the road already macadamized and brought to a good surface by consistent rolling with a heavy roller. The macadam under the tar coating would appear to remain satisfactory as long as the tar coating remained on the surface; immediately the tar coating became worn to the macadam, however, the latter rapidly ravelled. If the bituminous material could, therefore, be so highly filled with bitumen that the latter acted as the principal wearing agent and did not mark under traffic conditions, and similarly withstood the late autumn weather and traffic, the result would be of great benefit to roads where tar coating was now a success in the summer and a failure in the winter. A section has been laid, barely an inch thick, which consists of about 16 per cent. bitumen, and the cost will not be more than about 2s. to 2s. 6d. (25 to 35 cents) per superficial yard; the success of the material however, depends upon how it withstands weather and traffic conditions.

LAYING WOOD PAVING IN LONDON

By S. R. Church, Manager Research Department, Barrett Manufacturing Co., New York.

A careful study of wood block pavements and the methods of laying them in England showed the author of the paper from which this article is taken that the material differences from American practice are not in laying, but in relaying blocks after a pavement has been disturbed, and this is what he told the Wood Preservers' Association.

WE had an opportunity of carefully observing the construction of a wood pavement in Gracechurch street, London, and were greatly impressed with the good workmanship displayed. The street is in the heart of the old city, and is 34 feet wide. It was being paved for a distance of about six blocks. The contractors were allowed to shut the street off from traffic for a definite period of time, within which the work must be completed. The old asphalt pavement had been entirely removed, and a new cement-concrete foundation nine inches deep was put down. This concrete was put down in sections about 25 feet long, and the full width of the street. It was laid in one course, with a very wet mix, the metal being Thames gravel and sand. The concrete surface was finished to an absolutely true grade by means of a wood templet, and without the use of any mortar course. Sometimes a mortar course is used to make the surface smooth. In all cases the concrete is allowed to set six or seven days until perfectly hard, and the blocks are then laid directly on the hard, smooth concrete, without any cushion. This is universal practice, not only in London, but in Paris and Berlin, and all the engineers with whom I talked said that they were opposed to the use of a sand cushion or a soft cushion of any kind. The blocks were five inches deep by three inches wide by seven inches long. They were very uniform in length and exceedingly true in depth. They were laid fairly close, but not rammed. An expansion joint 1½ inches wide was provided along either curb, and two rows of blocks laid parallel to the curb, with a pitch-filled joint between these rows. The expansion joint along the curb was filled with clay to within one-half inch of the top. Before paving up to projections, such as manholes, pipe valves, etc., the blocks are fitted with great care around all these projections. Over the finished surface after the blocks are laid, a flush coat of hot coal tar pitch, of about 140 to 145 degrees Fah. melting point, was poured from hand buckets, and this was immediately squeegeed over the surface with rubber rollers, forcing it into all the joints. This was followed with a thin wash coat of cement grout, and finally a substantial layer of fine, brown, siliceous gravel, free from dust or loam, which was allowed to remain on the surface until pounded into the blocks by traffic.

The foregoing is typical of modern English practice. I have seen statements to the effect that spacing lath are commonly used in the joints, but this practice has been abandoned, except in the case of some hardwood pavements. The spacing strips are never used in London or Paris with softwood blocks. They are, however, used in Berlin. The flush coat of pitch over the surface is the universal practice in England, altho not used to any extent elsewhere. Longitudinal expansion joints are always provided, even on heavy traffic streets, but lateral expansion joints are not used. In London,

LAYING *five-inch creosoted deal blocks on concrete foundation in Grace Church street, London, showing all stages of handling blocks on the street.*

five-inch blocks are used on all important thoroughfares, and no blocks less than four inches deep are ever used.

In most of the London paving the blocks are delivered just about as fast as they are required. They are seldom piled along the sides of the streets.

Pinus sylvestris is used almost exclusively under such names as Swedish pine, Baltic pine, yellow deal, red deal, etc. Block after block shows no noticeable difference in weight, size of rings, freedom from knots, shakes, etc. The manager of a creosoting company attributes the success of their pavements to the quality of the wood. Straight pressure treatment is used, London requiring 12 pounds of coal tar creosote oil per cubic foot and Westminster 10 pounds, of about 1.06 specific gravity. Plant methods are thoro and well regulated, but not mechanically equal to American works. There is much hand labor.

Creosoted wood block pavements are not slippery because the wood is soft enough to permit the pounding into the fiber under traffic of the gravel or coarse sand spread over the completed pavement. They do not present as attractive an appearance nor are they quite as noiseless as our creosoted yellow pine. The wear of blocks is ordinarily very uniform with some exceptions in the downtown streets of London proper, where traffic is heaviest.

It requires very close scrutiny of pavements to find replaced service cuts or places where the pavement has been patched. The great care with which this work is done is in marked contrast with

THE *blocks are placed carefully on the street, as seen at the right, and then laid in closely-fitting courses by the men at the left.*

SQUEEGEEING *the pitch flush coat applied to the surface of the blocks.*

the careless manner in which blocks are sometimes thrown into repairs in our city streets.

The hardwood blocks, ordinarily laid untreated, comprise Australian jarrah and karri, species of eucalyptus. They are going out of favor rapidly, their use having proved a failure.

Creosoted wood is, without question, the most highly esteemed paving material in the English cities. In ten of the twenty-eight boroughs constituting the City of London, and comprising the most thickly populated sections of the city, the total mileage of creosoted wood block in 1912 was 121, and of this total 40 miles was in the city of Westminster, that part of London containing the best retail business streets; the government buildings, theaters, museums, art galleries, etc., the social heart of the city. The streets of Westminster are important thorofares. The traffic is, however, very largely rubber-tired. In fact, the percentage of iron-tired traffic, if known, would probably be surprisingly low. There are a few exceptions, such as the Strand, where there is considerable mixed traffic, but, on the whole, the streets of Westminster and those of purely residential boroughs, such as St. Marylebone, Kensington and Wandsworth, which together contribute ninety miles to the total of London wood paving, carry a traffic comprising a tremendous number of vehicles, but of a very nondestructive character to pavement. The City of London proper contains only eight and one-half miles of wood paving. Here the traffic is, of course, intense in all respects.

APPLYING *pitch coat to blocks. In the background the pitch coat has been followed by a flush coat of cement grout.*

GOVERNMENT OF CITIES

COMMISSIONS AND DEPARTMENTS COMPARED AND CONTRASTED

By Nelson P. Lewis, Chief Engineer, Board of Estimate and Apportionment of New York City.

In this abstract of a lecture before the students in highway engineering at Columbia University, the chief engineering adviser of the great city of New York gives the results of his mature experience and observation of the two principal forms of administering the public works, especially of the larger cities, and his conclusions must be accepted as the highest authority.

MOST American cities have a department of public works. The organization of such a department and the precise field covered by it vary in almost every city. Generally such a department has control over the preparation of city maps; street surface improvements, including grading, paving, sidewalks, maintenance, repairs and renewals; street signs and house numbers; sewers and sewage treatment; water supply and distribution, including the care of watershed, filtration, etc.; street cleaning, including the collection and disposal of wastes; street lighting; public buildings; the construction and reconstruction of surface railway tracks in streets, and the elimination of railroad grade crossings.

In cities of moderate size, say 300,000 or less, this work is usually under the more or less complete control of the city engineer, although there are conspicuous exceptions. In very large cities the organization is more complex, sometimes jurisdiction over but one or several of these activities being under a single administrative head; again, a larger group or all are under one head, but under a number of different administrative units, each with limited geographical jurisdiction. An example of the first class is the organization provided by the Greater New York charter, under which commissioners of water supply, sewers, street cleaning, bridges, public buildings, lighting and supplies each had jurisdiction over the entire city, and together they form the board of public improvements, the president of which, a separate officer appointed like the others by the mayor, had control over all topographical work. This was the charter which took effect immediately after the consolidation act which created the greater city. Everything was new. No definite policies had been established, and the results were generally unsatisfactory, although a conclusion that these results were due to the organization, instead of the chaotic condition which resulted from the consolidation into one city of a score or more of cities and villages, might not be justified.

An example of the second class is that of Greater London, where there are thirty separate administrative units, which are practically independent cities, each administering its own local affairs and raising the money which they feel they can afford to spend on the street and other services. The City of London comprises 673 acres and has less than 20,000 population. Even here, however, the London County Council has jurisdiction over certain municipal functions which are essentially metropolitan, such as the water supply, the main drainage system, the surface railway lines traversing two or more boroughs, and certain street im-

provements which extend beyond the limits of a single borough and which are of great importance to the entire metropolitan district.

¶ BOTH *the department and the commission plans are in operation in New York City.*

In the present City of New York is found a combination of these two general plans. The head of each of the five boroughs has entire control of the mapping of its territory, the improvement of its streets, including the maintenance and renewal of pavements, the design, construction and maintenance of sewers, including sewage treatment plant, and of all public buildings and offices, and in two of the boroughs of street cleaning and the disposal of wastes. Other functions which necessarily relate to the entire city and where local jurisdiction would be unsatisfactory are under control of department heads appointed by the Mayor, and they have jurisdiction over the entire city. The chief borough officers, together with the Mayor, the comptroller and the president of the legislative body, form the Board of Estimate and Apportionment, which body has a pretty general control over all city activities, so that the City of New York comes nearer having a commission form of government than is generally realized. There always have been and there still are in the City of New York a number of special commissions. The Brooklyn Bridge was built and operated by such a commission when it was an inter-city bridge. The new East River Bridge, now known as the Williamsburg Bridge, was also built by a separate commission. Brooklyn has had the Atlantic Avenue Improvement Commission, the Shore Road Commission and the Brooklyn Grade Crossing Commission, while the greater city has the Metropolitan Sewerage Commission; the Board of Water Supply, having control of the development of the Catskill watershed, and the Public Service Commission for the First District. This last-named commission is a peculiar one. It was created by the State, and its members are appointed by the Governor, the city authorities having no voice in their selection, and, while the salaries of the commission and a few of the administrative staff are paid by the State, the expenses of the vast majority of the staff, amounting at the present time to nearly $2,000,000 annually, are paid by the city, and the chief function of the commission is to spend money raised exclusively by the City of New York without any contribution whatever from the State, which created the commission. Certain public or semi-public activities are carried on by organizations having no official connection with the city, but which are allotted certain funds for enterprises which would otherwise doubtless be conducted directly by the city. Among such bodies are the Trustees of the Metropolitan Museum of Art, the Trustees of the Museum of Natural History, the Brooklyn Institute of Arts and Sciences, the Trustees of the Public Library and its great number of branches, the New York Zoological Society, which maintains the Zoological Garden in a portion of Bronx Park, and the New York Botanical Society, which has the care and custody of the remainder of the same park. No enumeration of special bodies whose influence has been potent in varying degree would be complete without naming the Bureau of Municipal Research, the Citizens' Union, the City Club and a host of civic organizations, representatives of which give the city officials the benefit of their advice on almost every subject, but none of which exercises such influence and actual power as do the three first named. None of these organizations has any responsibility to the people of the city.

¶ CHICAGO, *Baltimore, Louisville and other cities put much work in the hands of special commissions.*

New York is not alone in working thru special commissions. Chicago's park system is managed thru a separate commission for each park district, and the results appear to have been most satisfactory. The City of Baltimore has late-

ly established a Paving Commission, entirely distinct from the Department of Public Works or the city engineer's office.

¶ COMMISSION GOVERNMENT *for the entire city is the modern application of the plan.*

Then, there are the various forms of commission government, the commission in each city which has adopted this system having much latitude and the details consequently varying greatly. Perhaps the best and most efficient form of administration is that to be found in cities of moderate size, where one administrative head and the city engineer have virtually entire control. There is one serious defect which is the more pronounced in the smaller cities, and that is the practice, if not the right, of citizens to dictate to a certain degree what kind of improvements are to be made and their character. The town meeting method will answer very well for the village or the very small city, but, as the city grows, as its organization becomes more complex, there is more and more need for technical skill in the planning and execution of its public works, and, as the city grows, the general interests of the community and the particular interest of the property owner are likely to grow more and more apart. In the small town the individual and the property he represents form a much greater relative part of the population and of the physical city than is the case in the larger city. There is no field of municipal work where the engineer has the opportunity to develop greater versatility than in the moderate-sized city, corresponding, say, with cities of the second class in New York State. Here the city engineer, appointed by the Mayor, is a voting member both of the Board of Estimate and Apportionment and of the Board of Contract and Supply. He is called upon to exercise control over almost every kind of public work incidental to the modern city. The work may not be of the magnitude to be found in the greater cities, but its variety is far greater than that which comes to the engineer of cities of the first class, where jurisdiction and responsibilities are subdivided. Having less of a certain kind of work to do, he takes it very seriously, and it is often exceptionally well done. The practice of electing a city engineer by the Council or other legislative body, or, as is done in some cases, by popular vote, cannot be too strongly condemned. Past experience has given good ground for the general statement that no man should be selected to do professional or highly technical work by election, whether that election be by the general public or by a legislative body. Those who are called upon to vote for candidates for such an office have no means of knowing their peculiar qualifications or lack of qualifications, and better results will almost invariably be obtained if responsibility for the appointment of a man to do such work is vested in the chief executive of the city.

¶ DIVISION *of responsibility spells inefficiency in city administration.*

One of the most fertile sources of inefficient administration and of unsatisfactory results is a divided responsibility. In the City of New York the president of each borough is responsible for the care and condition of the public streets, and yet the Department of Water Supply, the Fire Department or the State-created Public Service Commission has the right to open the pavement for the purpose of installing the underground structures without the consent, and often without the knowledge, of the officer who is held responsible for the condition of the streets. The surface railway companies must secure permission from the Borough President to open the streets, but gas companies, electric light companies and telephone companies must also get permits from the Department of Water Supply, Gas and Electricity. In all these cases we have a dual responsibility which is inimical to proper control. An amusing instance of the lack of knowledge in one city department of what exists in city streets under the control of another department was afforded the speaker several years ago in the City of London.

Application was made to the authorities of the City of Westminster for the right to examine pipe galleries in Charing Cross road and Shaftesbury avenue. There was apparently no knowledge of the existence of such pipe subways, and, after extended inquiry, the speaker was told that there was no subway large enough for a man to enter. Upon application next day to the chief engineer of the London County Council, a member of the engineer's staff was immediately delegated to conduct the speaker through capacious pipe galleries in these two streets, while the Westminster authorities did not seem to be aware of their existence.

The following requisites are necessary in order to secure satisfactory results in highway administration:

1. Centralization of authority over and responsibility for all work relating to highways within the administrative district.

2. Such flexibility of organization as will permit a concentration of force on any work of pressing importance.

3. Administrative units sufficiently large to permit the utilization of an entire force and equipment all of the time, reducing overhead charges to a minimum consistent with efficiency and thoroness.

4. Get rid of the prevalent horror of a bureaucracy. If such a bureaucracy works well, it is a good thing. If it works badly, it is not because it is a bureaucracy, but because it is not well organized.

5. Direct and undivided responsibility for every part of the work, each head of a bureau or subdivision to be made to realize, however, that his own particular work should be so done as to help and not to hinder that of other bureaus or divisions.

6. Promotion to the headship of bureaus and departments to be made from within the organization when possible, not necessarily according to seniority, but by reason of peculiar fitness. When it is necessary to go outside of the organization to fill such a place, the appointee should be one who has already made good in similar work in some other place.

7. Permanent tenure of office for those in responsible charge, so that continuity of purpose and policy may be assured.

THE MORTON DENISON HULL PRIZE

The National Municipal League, thru the generosity of Hon. Morton Denison Hull, of Chicago, has established an annual prize of Two Hundred and Fifty Dollars, to be awarded for the best essay on a subject connected with municipal government. The competition is open to post-graduate students who are, or who have been within a year preceding the date of the competition, registered in any college or university of the United States offering distinct and independent instructions in city government. Subjects for 1914 are:

1. The history of municipal government in the United States during either one of the following periods: (a) from the Revolution to the Civil War; (b) from the Civil War to the present time.

2. The charter and the practical workings of government in any American city having a population of 50,000 or over.

3. The legal problems involved in the home-rule charter, with special reference to the experience of those states in which the system has been in operation.

4. The actual operation of the following features in American municipal government: (a) the initiative and referendum; (b) the recall; (c) proportional and minority representation; (d) limited and preferential voting.

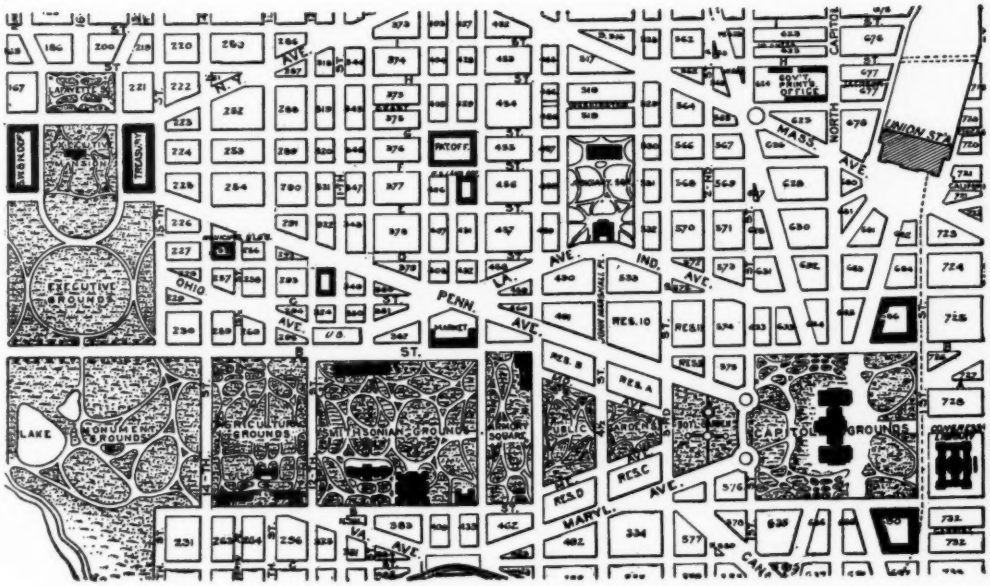
5. Public utilities' commissions, with special reference to the control of municipal public utilities in any state of the Union.

6. Municipal accounting and budget-making, with special reference to the actual results derived from the use of new and uniform methods.

7. The sources of municipal income in any state of the Union. (The study should deal with such matters as productiveness, cost of collection, and a general outline of each source. Competitors who think of choosing this subject should make sure that it has not been already covered by some published study, as, for example, in the case of Illinois).

8. The municipal charter system, whether general or special, in any state of the Union which contains at least two cities of more than 50,000 inhabitants.

May, 1914



ORNAMENTAL LIGHTING

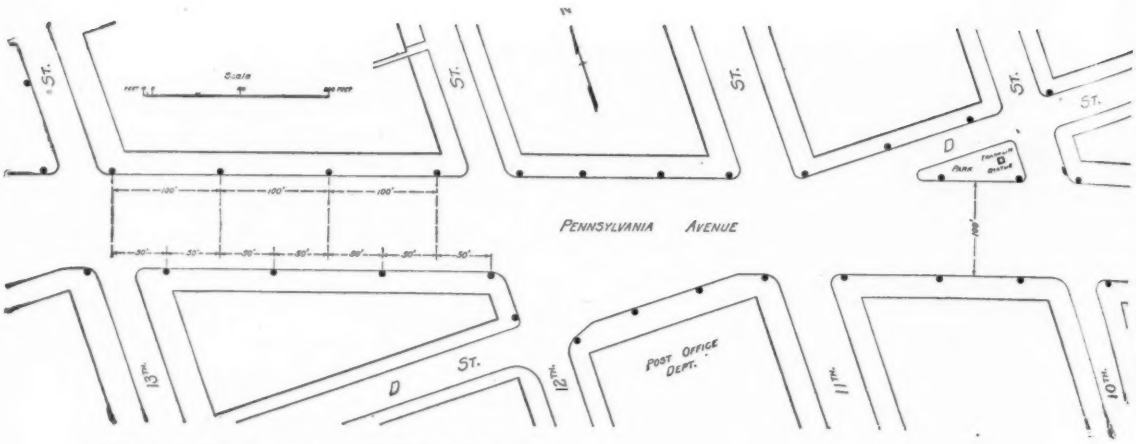
OF PENNSYLVANIA AVENUE, WASHINGTON, D. C.

PENNSYLVANIA AVENUE, in Washington, D. C., connecting the legislative and executive groups of public buildings, in the capital of the United States, is logically the proper street to be treated as the example of all that is imposing and beautiful in street planning and operation. For many years after the founding of the city this street was in darkness. According to Walter C. Allen, electrical engineer of the District of Columbia, in a paper published in the *General Electric Review*, the first appropriation for lighting the avenue was made in 1842, and it set apart $2,500 for this purpose to be used between the Capitol and the President's Square. Probably oil lamps were used because the first gas company began operations in 1848, and was authorized the same year to light Pennsylvania avenue, still at the expense of the United States Government. When the present form of government of the city was adopted, the lighting of the street was taken up by the Commissioners of the District. In 1886 there were 123 gas lamps on the street, costing $20 a year each, moonlight schedule, or $2,460.

After a few experiments in 1884 and 1885, a contract was let for lighting the street with twenty-four electric arc lamps at $248.20 each per year on all-night schedule, or $5,956.80 in all. The number of lamps increased later and they were supplanted by multiple inclosed arc lamps in 1902, which are now supplanted by the luminous arc lamps, the installation of which is described in the article referred to.

The map shows the commanding location of Pennsylvania avenue and the numerous widenings of view by open streets and grass plots at the intersections with the rectangular street system and with other diagonal avenues. It will be seen from this how ineffectual the early gas and electric lighting systems must have been.

The second of the accompanying drawings, showing the avenue between Tenth



PENNSYLVANIA AVENUE, *Washington, D. C., from Tenth to Thirteenth street, showing locations of ornamental lamps.*

and Thirteenth streets, will give some idea of the vastly greater illumination provided by the new system, and the location of the lamps around all the irregularities of the boundaries of the avenue and the street intersections and in the public places formed by them.

This installation requires for the entire 6,356 feet of the avenue, 123 lamps, the same as for the first gas installation. They cost $97.50 each, or $11,992.50 in all. The wonderful development in electric lighting, especially in reducing its cost, is seen by comparing the cost of operating this installation with that of the first installation of electric lights in 1886, the number of the new lights being more than five times the first and the annual cost being but twice as great.

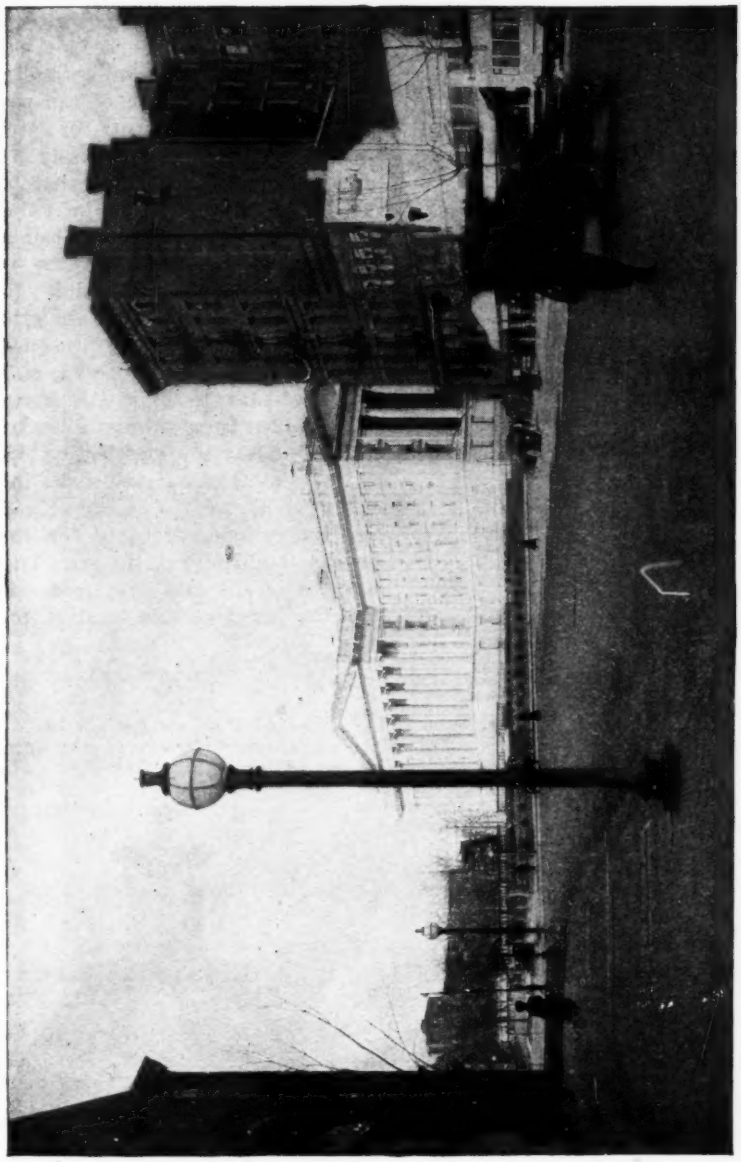
Two photographs of Pennsylvania avenue show the daylight appearance of the lamps on the street. One of these shows the east end of the street on the block between Fourteenth and Fifteenth streets and the other shows the same end, the photograph being taken from a point near Tenth street and showing a part of the lamps located in the second of the maps above referred to.

A drawing shows in detail the ornamental post and diffusing globe and a photograph gives a closer view of the globe with its ventilator and casing. Still another photograph gives a closer view of the lamp casing, opened to show the lamp mechanism.

This lamp is the standard 6.6-ampere 520-watt luminous arc lamp of the General Electric Company. There are some special features of the installation which are described by Mr. Allen.

The width of the roadway of the avenue proper is 109 feet between the curbs along which the lamps are placed, but there are numerous wider spaces, occasionally nearly doubling the width. The lines of posts are carried around these widened spaces as well as across some of them, keeping the average distance between posts about 100 feet. The area actually lighted is therefore materially greater than the 692,804 square feet in the roadway proper, including, as it does, the sidewalks, the intersecting streets for considerable distances and the triangular spaces, paved or parked, between these intersecting street lines.

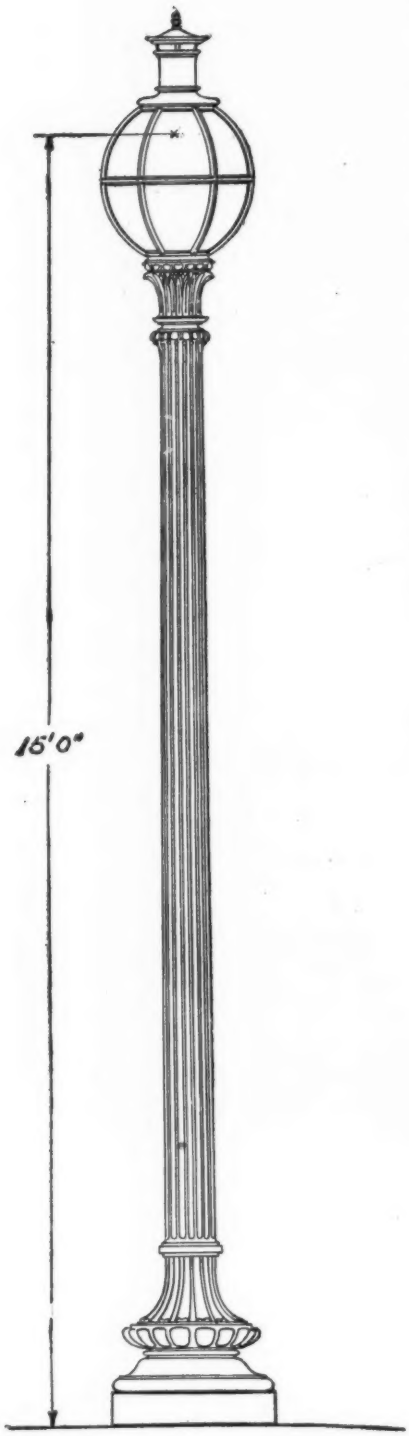
The lamps are served by cables in conduits laid many years ago in the roadway on both sides of the street, three feet from the curb line. The cables are single-conductor No. 8 B. & S.-gage copper, insulated with 8/32-inch varnished cambric and protected by ⅛-inch lead sheath. They are carried up the posts to the lamp terminals without breaking the lead covering, with no cut-out at the base of the post. Two circuits are used, connected with lamps so that after midnight one circuit can be cut out and the lamps on the other circuit will alternate



PENNSYLVANIA AVENUE, *Washington, D. C., near Fifteenth street, showing the new ornamental lighting posts and lamps and their locations.*

on the two sides of the street and thus make the illumination uniform, tho but half as great.

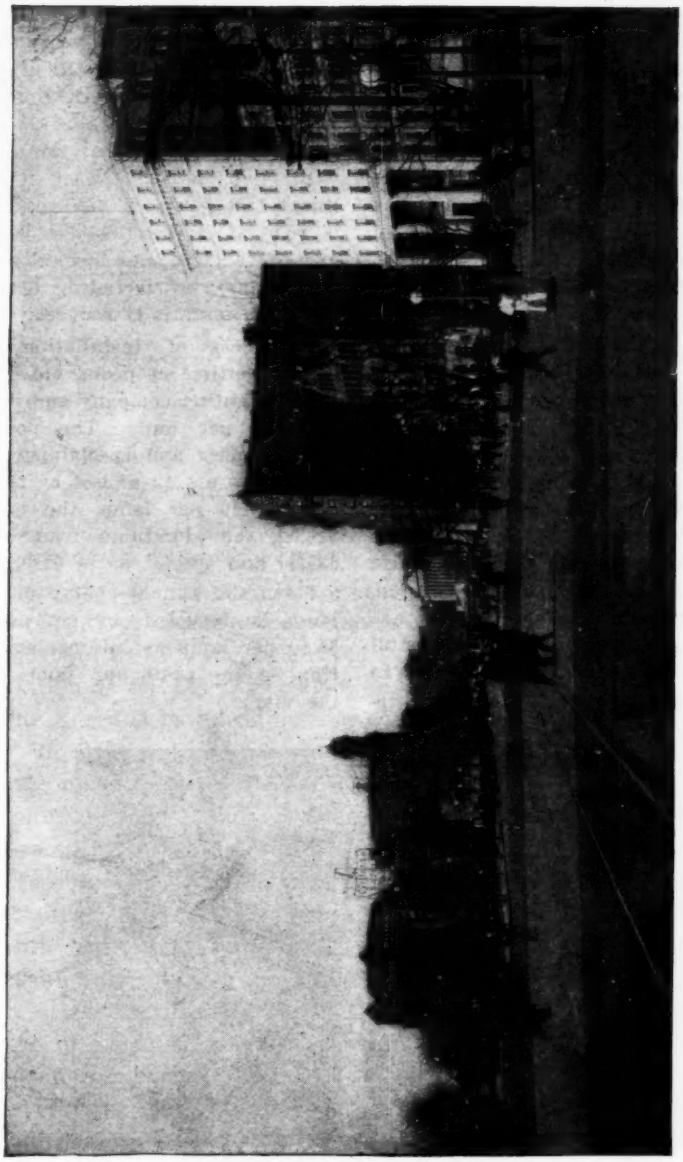
The posts were designed by James R. Marshall and Albert L. Harris, of the firm of Hornblower & Marshall, architects, of Washington, following the lines of the posts of their design used in the improved incandescent electric lighting system of the city. Full-size plaster models of posts with various designs of lamp casings and globes were made by John J. Early, sculptor, of Washington, and the final design was worked out from these models. Patterns were then made by the Union Foundry Company of Anniston, Ala., who secured the contract for the posts. They introduced an ingenious



method of locking the post to the base by a single turn of the shaft after inserting it in the top of the base, thus doing away with bolts or set-screws and greatly facilitating the erection of the posts.

The globe of the lamp is of special design. The cast ribbed frame is of aluminum, experiments showing that it gives the best results. It is in two hemispheres, upper and lower, being elongated about two inches in the vertical diameter. Polyclase alabaster glass is used, specially designed for use with luminous arc lamps by the Gleason-Tiebout Glass Company, of Broooklyn, N. Y. It was necessary to blow the glass as a sphere, about twenty-three inches in diameter, grind the top and bottom openings to size and then cut the globe into segments to fit the ribbed frame. This is accurately done, probably for the first time in the history of the art. The inner surfaces of the ribs are lined with felt and the glass is held against them by

THE LAMP *on its post in the drawing and the exterior of the lamp and casing in the photograph.*



PENNSYLVANIA AVENUE, *Washington, D. C., from point near Tenth street, looking northwest, showing the street in front of the postoffice, also shown in the drawing of this section of the street.*

equalizing spring fasteners, so designed that the pressure is distributed equally, besides providing for irregularities in thickness and allowing for expansion and contraction. The glass segments can be readily replaced by insertion from the inside of the frame while in position on the post.

"Medium" dense glass is used in the upper hemisphere and "light" in the lower half, both giving perfect diffusion with no shadows, no portion of the lamp mechanism or even the arc itself visible. The glass becomes a luminous surface emitting a powerful yet soft light without glare.

Insulators of special General Electric waterproof compound, instead of the

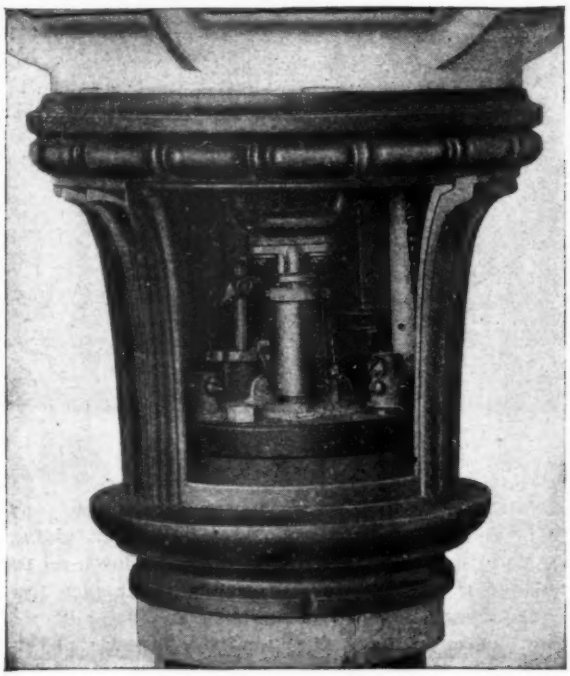
...ard glazed porcelain, are used be-...en the lamp mechanism and the top of ...e cast-iron post, being inclosed in the ornamental cast-iron casing surrounding the mechanism. The insulators are tested at 20,000 and 25,000 volts. A specially shaped ring of the same composition on top of the aluminum frame insulates the metal ventilator and upper fume box from the post. A cylindrical lining of mica, the sides of which are 3/16-inch thick, is placed around the mechanism within the cast-iron casing.

Access to the lamps for trimming is obtained by removing the ventilator on top and raising the upper fume box and insulator on the specially constructed flat slide rod. The rod is so located that when the lamp is burning the shadow of the rod is thrown on one of the ribs, which is large enough to cover it. The globe can be cleaned and the upper parts of the mechanism adjusted thru the top. The terminals and lower coils are reached thru a door in the ornamental iron casing below the globe, as shown in one of the photographs. The whole upper half of the ribbed frame can be removed if necessary.

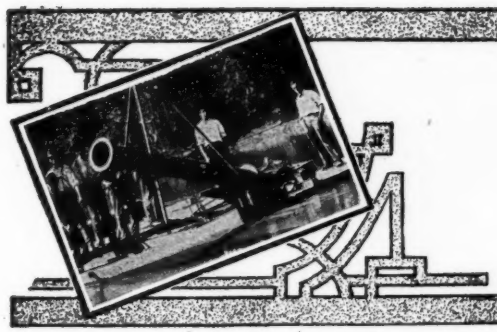
With 520-watt lamps every 100 feet on both sides of the street, the average watts per linear foot of street are 10.06, and with 109-foot width are 0.0923 per square foot. The cost per year for maintenance with lamps at $97.50 each is $1.886 per linear foot of street, and per square foot is $0.0173. If all the area of sidewalks and of the irregular spaces at street intersections were included, these averages would be materially reduced.

The cost of installation, including cables, setting of posts, etc., was borne by the lighting company and is estimated at $170 per unit. The posts, ribbed frames, glass and special parts of posts and lamps are furnished by the city and cost $67.40 per lamp, the post costing $26.90, the aluminum frame and glass $37.50 and special parts $3.00.

From the annual charge of $97.50 per lamp is deducted, by act of Congress, $4.40 per lamp as interest and depreciation on the posts and lamps owned by the city.



THE INTERIOR *of the casing at the base of the lamp and the mechanism for operating it.*



EDITORIAL

DEFECTS IN THE COMMISSION FORM OF MUNICIPAL GOVERNMENT

The New Jersey law providing the commission form of government for cities in that state has been in operation long enough to show the lines in which it is defective. These defects are stated in a recent number of the municipal paper of Atlantic City by an attorney, who has made special study of the subject. In brief, they are:

1. Directors or commissioners should be nominated for the particular position they are to fill and not elected in block, to be assigned to office by the commission as a whole after election.

2. The bureaus to be under the charge of each commissioner should be fixed by the law and not subject to changes of assignment as at present, so that three members of the commission can reduce the duties of any one or two to simple votes, without power or duty in any department or bureau.

3. Too small a minority (15 per cent. of vote) can start a proceeding to recall a commissioner and too soon after his election, tho he must have a majority of all the votes cast in order to be elected; and he should be accused with full authority of some nonfeasance or malfeasance in office before a recall petition can be carried thru.

4. In Atlantic City the highest five in the primary election have always been elected in the subsequent election, so that the double election is considered a useless expense.

Not every one will agree with the remedies hinted at in the above statement of defects. Some, for example, would select commissioners or a mayor and council at large to act as the legislative head of the city and require them to put the various departments in charge of appointed experts, who should be kept in their places as long as they are competent and can act in accord with the principles, plans and policies in the platform on which the commissioners were elected. Whether the departments shall be under one head with assistants responsible to him or under several heads responsible directly to the commission, or under boards responsible to them, are questions of local rather than general interest and should be left largely to the decision of the voters in each city, if the principle of home-rule is accepted.

Because Atlantic City has found the double election unnecessary up to this time, is no sign that it is not desirable elsewhere or will not be desirable in Atlantic City at another time. The defect may be in the method of putting candidates in nomination for the primary election rather than in the double election itself.

The second and third points seem to be very well taken and good remedies are suggested.

MODERN CONTRACTS WITH PUBLIC SERVICE CORPORATIONS

Few states as yet have Public Service Commissions which supervise the corporations, whether private or municipal, which render service to the public at large and to individuals under franchise or contract ordinance, but the work done by the commissions in existence and the publicity given to the results thereof are having their effect upon the contracts made by cities in other states with their own public service corporations.

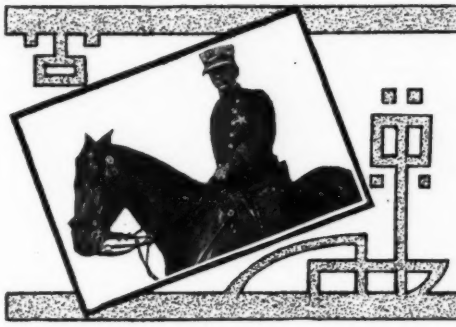
The profits of the corporations are no longer so surely considered the private business of those corporations but are recognized as the public business. The monopolies granted by the franchise contracts are recognized as subject properly to regulation as to rates as well as quality of service.

While many franchises are still considered perpetual even tho the companies operating under them are limited in life by the statutes, the companies must make contracts for public service at more or less frequent intervals. Whatever the length of these contracts may have been as at first granted, many of them are being renewed yearly, and there is an increasing tendency to limit profits to a reasonable figure, standardize rates so that every one will pay the same for the same service, and insist upon the best service available. When four gas, water, and electric light contracts come into a single office in one week for consideration there is indication of great activity in this direction.

Gas seems to be in particularly active condition at present. The experience of such companies as the Citizens Gas Company of Indianapolis, and the Consumers Gas Company of Toronto, has aroused an interest in the possibilities of good service at low rates, and several other cities have new gas contracts under consideration at this time.

ELECTRIC LIGHTING ADVANCE

The articles in this number of MUNICIPAL ENGINEERING, including one on ornamental lighting, one on municipal management of an electric light and power plant and one on a recent contract for the lighting of a city by a private company, as well as the striking illumination of the tower of the Buffalo building of the General Electric Company, shown on the cover, show the enormous advances which the science of electric lighting has made in quality and quantity of light furnished and in reduction in cost. The latter is quite as noticeable as are the two former, and is shown in the articles referred to, which will well repay the time it will take to read them.



QUESTION DEPARTMENT

Best Contract Between Engineer and Municipality

I should be pleased to know what would be the most advantageous agreement for an engineer with a municipality; the stipulations of the agreement. R., ———, Can.

Will engineers who have satisfactory contracts of this sort other than straight salaries communicate their terms, for transmission to our correspondent, confidentially or for publication with or without names as they may prefer?

The principal difficulty in making an equitable contract is in estimating the time necessary to complete the contract fully. This depends first upon the actions of the council in starting the work, letting the contract, etc.; second, upon the diligence of the contractor in prosecuting the work, and third, upon the ease of making a settlement between the parties. The time of inspectors and to a certain extent the time of the engineers is affected by these chances for delay.

Probably the most satisfactory contract from the standpoint of the engineer is one made on a percentage basis, a certain percentage of the estimated total amount of the contract being due on presentation of the preliminary report, a certain additional percentage on the presentation of plans and specifications, a certain additional percentage on the completion of the work. The first payment, for the preliminary report, may be a lump sum. The percentage on completion of work should cover the engineering work upon the construction of the work and may or may not include the inspection. On account of the chances for delay referred to, over which the engineer has no control, it should be more satisfactory to both engineer and city to leave the payment for inspection out of the engineer's contract, the city paying the inspectors directly. However, if the engineer is to be properly responsible for the work he must control the appointment and length of service of the inspectors within reasonable limits.

This is a subject on which each engineer has his own opinions and discussion of the subject is invited.

Tractors for Hauling Road Materials

I would like full description of medium weight tractors for us in hauling road material, and of wagons used with them. We have seen no ten-ton outfit but what is not suited for the conditions under which we have to work. T., ———, Fla.

Names of manufacturers of traction engines and trucks will be found in the "Business Directory" published in each number of MUNICIPAL ENGINEERING under the headings "Automobiles," "Engines," "Motor Trucks," "Road Rollers," "Traction Engines," "Traction Engines (Oil or Kerosene)," "Trucks, Motor."

If some statement of the conditions were given it would be possible to give some idea of what machine would best suit them.

Can You See Thru a Wall?

Can you inform me of any way by which a person in one room, with closed doors, can see what is going on in an adjoining room?

I am very anxious for information bearing on this subject and willing to pay liberally for same. N., Chicago, Ill.

This is apparently a puzzle for the solution of which a prize is offered, tho the amount of the prize is not stated. The editor takes the liberty of barring holes and cracks in the wall or other obvious methods of observation of the next room.

Gas Works Builders and Gas Rates

Give us the names of companies who install gas plants, both large and small.

Also, such information as you may have concerning cost of producing gas and success of competing plants.

M., Atlanta, Ga.

Coke ovens from which gas is produced as a by-product, such as those used by the Citizens Gas Co., of Indianapolis, are the

United Otto of the United Coke and Gas Co., 17 Battery Place, New York, H. Koppers Co., 5 S. Wabash St., Chicago, Ill., and the Semet-Solvay of the Semet-Solvay Co., Syracuse, N. Y.

There are many manufacturers of gas works machinery and builders of plants of which the following may be considered representative:

Coal gas plants are constructed by the Gas Engineering Co., Trenton, N. J., American Coke and Gas Construction Co., Camden, N. J., Gas Machinery Co., Cleveland, O., Kerr-Murray Mfg. Co., Ft. Wayne, Ind., Bartlett Hayward Co., Baltimore, Md., United Gas Improvement Co., Broad and Arch Sts., Philadelphia, Pa., Western Gas Construction Co., Ft. Wayne, Ind., R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa.

Producer gas plants are made by many manufacturers among which are the De La Vergne Machine Co., E. 138th St., New York, Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill., Power and Mining Machinery Co., 115 Broadway, New York, Wellman-Seaver-Morgan Co., Cleveland, O., Westinghouse Machine Co., East Pittsburgh, Pa.

Water gas making machinery is installed by the Gas Machinery Co., Citizens Building, Cleveland, O., the United Gas Improvement Co., Philadelphia, Pa.

Acetylene gas plants are furnished by the Davis Acetylene Co., Elkhart, Ind., National Light and Heating Co., Freeport, O., A. Alexander Milburn Co., 1420 W. Baltimore St., Baltimore, Md., and many others.

Gasoline and naptha gas plants, small, are supplied by the Sun Co., Morris Bldg., Philadelphia, Pa., Gilbert & Barker Mfg. Co., Springfield, Mass.

The cost of producing gas is so much a factor of the quality of the gas and the use to be made of it and of the other products of the process that no figures of value can be made without full knowledge of the plans and of the materials to be used and of the business to be done.

To say that the gas made in the by-product coke ovens of the Citizens Gas Co., of Indianapolis, costs nothing or is put in the holder at a credit means nothing except that the coke business of the company is profitable even if the gas is wasted. Where the coke could not be sold at good prices this statement would not be true. The cost of distribution must be added, and the company is making good profits selling gas at 55 cents a thousand. The Birmingham Railway & Electric Light Co., recently offered that city by-product gas at 55 cents after three years at somewhat higher prices, but the quality of gas available seems to have been so poor that the city did not accept the offer. Again, a small water-gas plant was allowed a rate of $2.00 for small consumers because the commission thought this rate was necessary to pay proper return on the money invested. It is thus evident that a comparison of rates in different cities is of little or no value unless many details of conditions are fully known.

The question is one which should be put in the hands of an engineer not biassed in favor of any one system of manufacture, who knows the field and its possibilities for full study and report, after which and on the basis of which decisions as to plans general and detailed can be made.

Lists of rates in various cities will be found in MUNICIPAL ENGINEERING, vol. xlv, pp. 49, 376, xli, pp. 225, 228, and a long list in towns of 5,000 to 10,000 population in vol. xl, pp. 38, 125, 220, 347.

Garbage Collection and Disposal for Minnesota City

This city is contemplating installing a system of garbage collection and disposal. They would like to correspond with other city officials in this matter, and if possible have them send any information they may have where such methods are now in use and are operated successfully. Also copies of ordinances relating to the same.

Can you give this some space in your magazine, making our wants known?

———, City Engineer.

This information will be of interest to many cities and our readers are requested to forward what they can to the editor, who will send it on to our correspondent and also use it in articles on the subject. There are many articles in the last six or eight volumes of MUNICIPAL ENGINEERING which will be of interest in this connection.

Books on Water Analysis

Can you give us the name of a hand book or publication which would give complete instructions so as to enable us to analyze our water supply from time to time, with special reference to bacteriological analysis?

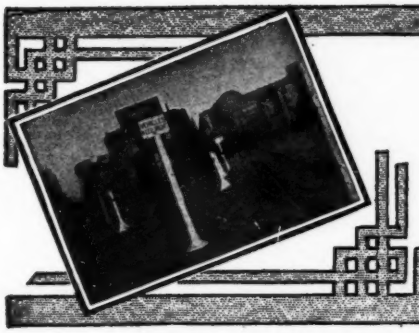
S., Kane, Pa.

Perhaps the fullest discussion of water analysis from the bacteriological standpoint is to be found in Prescott and Winslow's "Elements of Water Bacteriology with special reference to Sanitary Water Analysis." ($1.75.)

Whipple's "The Microscopy of Drinking Water" ($3.50) is devoted to the minute organic life in water other than bacteria.

Stock's "Water Analysis for Sanitary and Technical Purposes" ($1.50) is an English book giving methods of making chemical examinations of water.

Mason's "Examination of Water" ($1.25) is a small book giving brief and clear statements of methods of analysis, both chemical and bacteriological.



WORKERS IN THE FIELD

Comparison of Operations of Private and Municipal Electric Plants of Pasadena, Cal.

The Editor of MUNICIPAL ENGINEERING:

Sir—I note in *Public Service* of March, on pages 75 and 76, reference is made to Pasadena's municipal lighting plant. I thought this would be a good time to show the real comparison of the operation of a public service corporation and the municipal department of the City of Pasadena, both reports having been filed for the year ending December 31, 1913.

I have made a comparison of the two utilities, and I am sending you a copy, which you are free to use. In analyzing the report I wish to call your attention to the following facts:

	Edison.	City.
Number of kw. hr. generated for distribution and delivered for distribution by our competitor and this department	5,356,140	5,446,000
Percentage of current lost and unaccounted for	20	19
Total income	$146,066.47	$161,182.20
Total operating expense, including depreciation, but not including interest on investment	$155,000.53	$109,532.27
Average rate of depreciation (per cent)	5	4.44
Net receipts	.....	$51,649.93
Deficit	$9,286.26	.....
Net income and surplus	.....	$30,298.25
Deficit	$46,904.72	.....
Average rate received for light (cents per kw. hr.	3.89	4.95
Average rate received for power (cents per kw. hr.	3.49	1.87
Average rate received for street lighting cents per kw. hour)	.....	4.91

It might be of interest to mention that the expense of our competitor for all of those items other than generation and distribution, applying to general expense, office expense, new business expense, etc., amounted to $49,610.45, as compared to this department's $17,881.67.

You will note that the amount we received per k.w. hr. for our street lighting was 4.91 cents, while the amount we received for commercial and residence lighting was 4.95 cents, showing a higher average rate from the sale of electrical energy for commercial and residence lighting than that which we received for street lighting. This is just the reverse of what is claimed in the attacking article.

I wish to call your attention to the fact that the opposition company charged a 4-cent rate for nine months of the year as against our rate of 5 cents, and the reason that the opposition company had to raise their rates to the same as those charged by the city for electrical energy for lighting was that they had been running at a loss, and they would have been obliged to lower their rates in all of the other towns to which they supplied electrical energy to the same as those charged in Pasadena if they had not raised their rates to the same as those charged by this department in Pasadena.

You will note that their loss in competition with the city was $46,904.72, figuring their interest rate on the investment that they claim at 4 per cent. This is a very interesting comparison and shows that the large corporation has overhead expenses beyond all reason, and when it comes to real competition they cannot compete with a municipality that runs its business according to business principles.

C. W. KOINER,
General Manager, Municipal Lighting Department, Pasadena, Cal.

COMPARISON OF OPERATING REVENUES AND EXPENSES OF PASADENA'S MUNICIPAL AND PRIVATELY OWNED ELECTRIC LIGHT AND POWER PLANTS.

		Edison City of Pasadena	M. L. D. City of Pasadena	Edison Outside of City	M. L. D. Outside of City	Edison Total	M. L. D. Total
	OPERATING REVENUE—						
1.	Municipal St. Ltg. —Arc	.....	.....	60,071.84	.....	60,071.84	.....
2.	Municipal St. Ltg. Incan.	.....	47,701.16	83,671.70	.....	83,671.70	47,701.16
3.	Municipal Ltg.— Misc.	.....	.....	14,175.58	.....	14,175.58	.....
4.	Com'l Ltg—Flat.	.....	.....	11,357.50	.....	11,357.50	.....
5.	Com'l Ltg. Met.	106,115.28	75,228.18	1,890,006.89	4,157.92	1,996,122.17	79,386.10
6.	Total Lighting	106,115.28	122,929.34	2,059,283.51	4,157.92	2,165,398.79	127,087.26
7.	Municipal Power.	14.34	.....	93,382.31	.....	93,396.65	.....
8.	Com'l Pow'r—Fl't	.....	.....	176.75	.....	176.75	.....
9.	Com'l Power—M.	37,373.85	27,618.34	1,607,576.40	6,476.60	1,644,950 25	34,094.94
10.	Railway Power.	.....	.....	377,150.16	.....	135,758.98	.....
11.	Other Elec. Corp.	.....	.....	135,758.98	.....	135,758.98	.....
12.	Misc. Power Rev.	.....	.....	280.83	.....	280.83	.....
13.	Total Power	37,388.19	27,618.34	2,214,325.43	6,476.60	2,251,713.62	34,094.94
14.	Total Light and Power (6+13)	143,503.47	150,547.68	4,273,608.94	10,634.52	4,417,112.41	161,182.20
15.	Mdse. & Job. Rev.	2,558.00	.....	47,471.37	.....	50,029.37	.....
16.	Rent of Elec. Appl.	5.00	.....	5,886.37	.....	5,891.37	.....
17.	Total Op. Rev.	146,066.47	150,547.68	4,326,966.68	10,634.52	4,473,033.15	161,182.20
	OPERATING EXPENSES—						
18.	Pro. & Tran. Exp.	20,437.69	43,577.80	767,284.24	.....	787,721.93	43,577.80
19.	Distribution Exp.	35,846.82	22,608.75	515,583.33	.....	551,430.15	22,608.75
20.	Coml Exp.	24,683.48	.....	213,572.63	.....	238,256.11	.....
21.	General Exp.	24,927.17	17,881.67	399,357.39	.....	424,284.56	17,881.67
22.	Taxes	6,210.02	.....	196,517.23	.....	202,727.25	.....
23.	Total Op. Exp.	112,105.18	84,068.22	2,092,314.82	.....	2,204,420.00	84,068.22
24.	Add Depreciation	42,895.35	25,464.05				
25.	Total. Op. Exp. & Dep.	155,000.53	109,532.27				
26.	Balance (17-25).	8,934.06	51,649.93				
27.	Less Uncollectible Bills	.352.20	*				
28.	Net Op. Rev.	9,286.26	51,649.93				
	Interest on Bonds		11,659.38				
	Interest on Floating Debt		9,692.30				
	Net Income		30,298.25				
	Surplus at beginning of year.		24,661.59				
	Surplus at close of year.		54,959.84				

* Included in General Expense.

The main table accompanies, showing the operating revenues and operating expenses of the two plants, that of the municipal lighting department and that of the Edison Company, as taken from their reports:

Explanation of City Proportion.

Gross Revenue—The amount shown as gross revenue, inside and outside of the City of Pasadena, represents the actual bills rendered to consumers inside and outside of the city.

Operating Expenses—Production and Transmission Expenses—"Capacity Expense" is apportioned on a basis of the average peaks inside and outside of the city. "Output Expense" is apportioned on a basis of kw. hrs. sold inside and outside of the city.

Distribution Expense—All of the items under Distribution Expenses are apportioned on the meter basis except Sub-Station Expenses (Sub-Station Reprs., Sub-Station Supplies and Expense, Reps. Sub-Station Buildings and Genl. Structures, Reps. Sub-Station Equipment), which are apportioned on the basis of the maximum demand on Station inside and outside city; Commercial Arc Lamp Expense (Commercial Arc Labor, Commercial Arc Supplies and Rep., Repairs Commercial Arc Lamps), which are apportioned on a basis of the number of Arc Lamps inside and outside of the city, respectively; Commercial Incandescent Lamp Installation and Renewals, is apportioned on a basis of the number of Incandescent Lamps inside and outside of the city respectively.

Commercial Expenses—All of the items under Commercial Expenses are apportioned on a basis of the number of meters inside and outside of the city.

General Expenses—All of the items under General Expenses, except General Office Expense Proportion, are apportioned on the meter basis; General Office Expense Proportion is apportioned on a basis of the Gross Earnings Light and Power, inside and outside of the city.

Taxes—Taxes are apportioned on a basis of the Gross Earnings inside and outside of the city.

The expense to the Municipal Lighting Department for furnishing current without the city limits is practically the same per kw. hr. as that for supplying it within the city for both light and power.

Other tables show the amount of current corresponding to each item in each line of the table of operating revenues; the details of the items of operating expenses, showing the differences in classifications of items in the two systems of bookkeeping; the account of materials and supplies passing thru stores and sales departments; and the cost of equipment and plant in detail.

The total value of the plant of the Edison Company is $22,560,686.98, of which only $914,615.79 is in Pasadena. This valuation is to be compared with that of the municipal plant for an output almost exactly the same, $656,807.23 at the end of the year, every cent of which has been fully accounted for. The principal differences in items are in real estate and buildings, about $60,000; transformers, $19,000; meters, $35,000; and about $145,000 in various items of transmission and distribution equipment, in which the company's plant exceeds the city's plant in cost.

The table giving the account of electric energy shows the almost exact equality in amount of business of the two companies, as follows:

Curent.	Edison Plant kw. hr.	Municipal Plant kw. hr.
Commercial lighting, metered	2,701,262	1,602,170
Used by co. or city	24,930	34,695
Municipal lighting	.....	969,787
Total lighting	2,726,192	2,606,652
Commercial power, metered	1,558,718	1,820,303
Total accounted for	4,284,910	4,426,955
Lost and not accounted for	1,071,230†	1,039,045*
	5,356,140†	5,466,000*
Maximum demand in any one day in year	2,027	1,940
Minimum demand in one day	no data	250
Percentage of loss	20†	19*

*Actual, metered.
†Estimated.

The inventories show that the Edison Company prefers having about 70 per cent. of 40 and 45-foot poles and the city uses 80 per cent. of 35, 40 and 45-foot poles. The company has 4,852 poles, in 742 of which it has only part interest, and values them at $82,707.52, while the city has 5,504 poles, all its own except 26 in which it owns a half interest, and values them at $66,100.84.

The other inventories show mainly such differences as the methods and dates of building the plants and the demands of development and displacement of old equipment might explain in large degree.

The attempts to discredit the Pasadena municipal plant seem most of them to be ill advised, and they react to show or even possibly to exaggerate slightly the economies of its operation. They doubtless also have the effect of keeping the management and the employes always up to their best efforts, and are in this respect also of real benefit to the City of Pasadena.

Inspector's Handbook.

Referring to the inquiry for books on inspection, page 378, your April issue, and your answer thereto; it may be of interest of your correspondent to know that in the second edition of my little book on "Specifications for Street Roadway Pavements" (The McGraw-Hill Book Co. 1913, $1.00) will be found a carefully prepared set of "Instructions to Inspectors on Street Paving Work," occupying 25 pages.

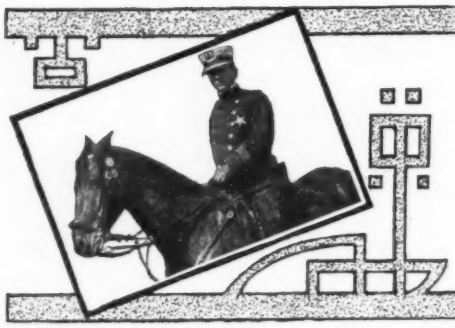
S. WHINERY,
Civil Engineer, 95 Liberty street, New York.

Municipal Tour in Europe

Robert S. Binkerd, secretary of the City Club of New York, will lead a group of city officials in a tour of European cities for the purpose of studying and observing municipal government at first hand in Copenhagen, Berlin, Dresden, Munich, Ulm, Frankfort, Dusseldorf, Essen, Amsterdam, Brussels, Paris, London, Liverpool and others, covering all lines of municipal activity. He will have several assistants expert in various branches of municipal activity and in languages. The trip will occupy July and August.

Portland Cement Production in 1913

The final figures for the Portland cement industry in 1913, as obtained by the United States Geological Survey on March 16, show a production of 92,097,131 barrels, shipments of 88,689,377 barrels and stocks on hand, 11,220,328 barrels.



LEGAL DECISIONS

Decisions of Higher Courts of Interest to Municipalities

City's liability for insufficient water supply accrues only after failure to correct defective system. After a water main had been extended by the city to annexed territory, the board of health in December, 1911, notified the plaintiff to connect his premises with it, which he did in January, 1912, and it appeared, after trial, that the quantity of water on the second floor of plaintiff's house was not sufficient to flush his closets, and the supply was so diminished by other buildings being connected with the main that after about a month plaintiff had no water at all for his bathroom, which facts plaintiff reported to the authorities and suggested that his premises be connected with a standpipe intended to supply an adjoining district, which was refused on the ground that such diversion would render the supply of the persons in that district inadequate. A few days after July 18, 1912, plaintiff and others signed a petition requesting action by the city to remedy the defect in their water supply, and the authorities immediately directed that the main be connected with another pipe, which was done four days thereafter, and which gave plaintiff sufficient water. *Held*, that the city was not liable in damages for the insufficiency of plaintiff's water supply when the main was first connected with his property, in view of its subsequent action in making an adequate supply available. The adoption of a plan for supplying a part of a city with water involves the exercise of a delegated governmental power, so that the city is not liable in damages for an error of judgment as to the adequacy of the system as originally installed, though it may subsequently become liable after it is clearly demonstrated by experience that the system is inadequate or defective. Stansbury v. City of Richmond (Va.), 81 S. E., 26.

Eminent Domain Appurtenant only to Public Service Corporation—Where the charter of a water company gave it power to hold real estate, take water, pipe it, and sell the same to individuals or corporations, make contracts, etc., but contained no provisions requiring the power to be employed directly for a public use, or forbidding it from using all the water obtained by it for a purely private use, such as a manufacturing business, or from selling it all to one person, the water company did not have the right of eminent domain. That the Legislature has given a water company the right of eminent domain and the grant has been accepted will not confer such right on the company, where the charter does not make the company a public service corporation, since the Legislature cannot make a use public by declaring it so, but it is for the courts to determine whether the declared uses are in law public uses. If a water company's charter by its terms does not make it a public service corporation, that it had always performed a public service would not give it a right of eminent domain. Norfolk County Water Co. v. Wood (Va.) 81 S. E., p. 19.

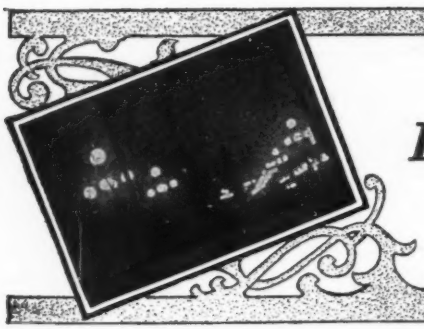
General Sidewalk Ordinance sufficient to Validate Individual Sidewalk Construction by Resolution—A city of the second class had in force a general ordinance relating to sidewalks, prescribing the width, material, width of space reserved, the manner of construction, and the procedure incident to the ordering of a sidewalk and its construction, a section of which ordinance gave directions touching the petition, notice, and resolution required in order to construct a sidewalk. The required petition, notice, and resolution were presented, given, and adopted, and the tax to pay for the work was levied by the enactment of an ordinance. *Held*, that the city acted in substantial conformity with the requirement of section 1374 of the General Statutes of 1909; that such work be authorized by ordinance; and that the collection of the tax should not be enjoined on the ground that the city had proceeded not by ordinance but by resolution. Dargatz v. Pauley, county treasurer, (Kan.) 139 Pac., 419.

Paving Assessment Valid if Property Owner Knowingly Fails to Present Objections at Proper Time—Where jurisdiction is conferred upon a municipal body to provide for paving its streets, and charge the cost thereof against the property benefited, according to the method provided by law, a property owner who stands by while such work is being prosecuted, with full knowledge that large expenditures are being made for such improvements which will benefit his property, or, upon due notice, fails to appear at the proper time and before the tribunal prescribed by law, and present his objections, if he have any, will not, after the work is completed, be afforded relief by injunction against assessments levied against the property benefited to pay for such work. City of Bartlesville et al. v. Hohn et al. (Okla.), 139 Pac., 273.

Contract for Improvement Cannot be Modified by New Contract—A city could not, after having awarded a valid contract for a street improvement, thereafter by a second contract release the contractor from performance according to the specifications of the first contract, and the remedy of the property owner was, under the express provisions of Street Improvement Act an appeal to the city council, which could set aside the assessment and order the work done according to specifications. McIntyre v. City of Los Angeles (Cal.), 139 Pac., 240.

Natural Water Course—City not Liable for Water Damage from Grading Streets—A channel in which water never flowed except when the ground was frozen and snows melted in the late winter or early spring, and then as mere surface drainage over an entire tract, occasioned by unusual freshets, was not a "natural water course." Damages cannot be recovered for consequential injuries to private property occasioned by the original grading of streets and alleys, since their dedication implies an agreement of the dedicator and his successors that the city may improve. Surface water caused by the falling of rain or the melting of snow is to be regarded as an outlaw or common enemy against which every proprietor of land may defend himself, even if, in consequence thereof, injury results to others. A city which, in making an initial grade of streets, filled in an old dry channel where it intersected such streets and constructed culverts sufficient to have carried off the water running in the channel at certain seasons, but which were useless because private owners had filled in the channel on their lots, was not liable for casting surface water on plaintiff's property, since the filling in of the private lots was the proximate cause. Thorpe et ux. v. City of Spokane, 139 Pac., 221.

City Liable for Damage from Obstruction of Street Drainage—Before plaintiff's lot had been raised so as to be somewhat above the proposed street grade except in the rear, a ditch was dug along the street by another adjacent owner with the city's consent or acquiescence for the purpose of draining away the surface water, and thereafter the city engineer, merely in view of raising the street in the future and not for making a present improvement, dumped waste material in the street so as to make an embankment across the ditch and dam up the surface waters, which were thereby cast on plaintiff's land in a greater volume than they would have naturally flowed thereon. *Held*, that the city was guilty of an actionable wrong in thus impounding waters and casting them upon plaintiff's land. In an action against a city for damage to property by impounding surface water in a street and casting it upon plaintiff's property, the court instructed that the term "Act of God" applied only to events in nature so extraordinary that the history of climatic conditions in the locality afforded no reasonable warning of them, and liability for injury caused by floods cannot be avoided, on the ground that the flood was an act of God, where it might have been expected, though it occurred infrequently, and that even though the city had caused material to be dumped in the street, yet if the storm which caused the injury to plaintiff's property was so overwhelming in character that it would of itself produce the injury independently of the material, then the jury must find for defendant, and further instructed that, to give a body of water the character of an extraordinary flood, it is not necessary that it should be the greatest flood within memory, but its character should be tested by comparison with the usual volume of floods ordinarily occurring. *Held*, that the instruction as a whole was that, if the storm would have caused the injury to plaintiff's property independent of the obstruction placed in the street, plaintiff could not recover. City of Tucson v. Dunseath (Ariz.), 139 Pac., 177.



FIRE AND WATER

Water Works Machinery and Devices

By E. L. Loomis, Superintendent of Water Works, Elkhart, Ind.

The author of this paper, which is from one read before the Indiana Sanitary and Water Supply Asociation, is a practical operator of a water works plant and always presents something of value. This article shows what economies can be secured by the use of devices which are well known but are not as commonly in use in small plants as they should be.

MORE than four-fifths of all the water plants of the state of Indiana belong to the smaller classes whose daily pumpages probably average less than one million gallons. As compared with the larger systems, these enterprises have relatively few consumers, limited revenues, and proportionately much higher fixed charges and operating expenditures. Therefore, it is easy to realize that the problems confronting such utilities as to economy and efficiency are of paramount concern. And the smaller the utility, all the greater becomes the necessity for the closest scrutiny into its plant operations for the detection and stoppage of waste, and for the economical conduct of its affairs generally.

A visit to almost any of the larger plants of the state will disclose the fact that they are not only equipped with all sorts of devices and facilities for the economical conduct of their enterprises, but will convince us also that they have experienced and technically trained men to manage and supervise them as well. Many of the smaller concerns likewise exemplify a similar degree of thrift and skill. To any of us, a detailed study of these systems and of their various kinds of operations for plant economy would be well worth while, and would doubtless yield abundantly in returns if the information thus acquired were adapted and applied, so far as practicable, to our own needs.

Only a few items will be here considered, and chief of them may be cited the pumping machine. As illustrating an experience in pumping economy, you will permit me to state the conditions as existing in our plant at Valparaiso, and to make a comparison of the costs of operating each of our three different types of pumps.

Our pumpage approximates 1,000,000 gallons per day, pumping direct against a total head of 85 feet. Our principal pump for continuous operations is a cross-compound, condensing engine, with Meyer gear and attached air pumps. Upon acceptance test when we purchased this machine two years ago it showed a duty of 78.57 million foot pounds per 1,000 pounds of steam used, pumping against our usual head at normal load.

Assuming an apparent evaporation of 7 pounds of water to each pound of coal, and a total head of 100 feet, with a working duty of about 70 million foot pounds per 1,000 pounds of steam, this machine will pump and deliver 1,000,000 gallons of water each day for one month at a steam consumption of 358,071 pounds, thus requiring 25.57 tons of coal, which at $3.50 per ton in bin, costs us $89.49. With our No. 2 reserve pump, of the non-compound, condensing, crank and fly-wheel type, assuming a working duty of only 50 million foot pounds, which is really a trifle too high, for the same pumping operation 501,300 pounds of steam would be consumed, requiring 35.80 tons of coal at a cost of $124.30. With our third unit, a simple duplex pump, which, needless to state, is rarely placed in service, 752,129 pounds of steam would be used, or 53.71 tons of coal costing us $187.98.

Thus it is observed that by using our No. 1 pump, for each month we operate we show a saving of $34.81 over pump No. 2, while over pump No. 3 we effect a saving of $98.49, or in round numbers, almost at the rate of $1,200.00 per year.

Such a saving to any small plant in a comparatively short time would be sufficient to buy and install the very best and most economical type of pump which the market affords.

In our own case it is plainly apparent that from the standpoint of even ordinary business economy we had better consign both of our low duty pumps to the scrappile rather than place them in continuous operation. As auxiliary units, for temporary emergency purposes, however, they, of course, have their place and value.

A good, durable, dependable and economical pump for the particular service required, is the very heart of every waterworks system, and no plant can reach its highest state of efficiency unless its pumping equipment combines all of these fundamental requirements.

The pumping machine for every plant should be designed so as to give the best possible economy at the normal load, but with ample capacity for the maximum requirements, such as the sudden opening of large connections, or where direct fire pressure is furnished at the hydrant nozzle. In almost all cases, operating economy should be considered in making a selection rather than the first cost. But the fixed charges on a high duty machine of the Corliss type, by reason of its higher first cost, the greater housing space required and its many complications, may sometimes more than counterbalance the saving over a simpler type, such as the Meyer gear.

While as heretofore noted, much saving may be effected by the use of properly designed pumping machines, likewise is the same degree of economy applicable to the boiler room. The kind of boilers, the character of fuel, and methods of firing are all-important questions in boiler room economies. For every plant the boilers should be in duplicate units, and like the pumps, of ample capacity for the peak load, tho not too large for the normal uses. As safeguards, the steam lines from the boilers to each pumping unit should be as nearly separate as possible. Obviously also should the boiler feed-water systems be entirely separate and independent.

In determining the kind of coal to be used, it has been our experience that dependence should not be placed upon the basis of heat units alone, but that the coals should be tried out, not merely for a few days under the most favorable firing conditions, but thoroly tested under the every-day working conditions of the plant just as they actually exist. Under such test, the coal evaporating the most water for the dollar manifestly should be the kind to adopt. Moreover, with propriety, and sometimes with profit as well, coal bought on contract may be tested from time to time as a check upon its continued good quality. For this purpose where the amount consumed will not warrant the purchase of a good bomb calorimeter, the lead-oxide reduction method may be used, such an outfit costing but a few dollars and the results being sufficiently satisfactory for purposes of comparison.

Where the coal storage room is located adjacent to railroad siding, if used in quantities sufficient to justify, coal conveying machinery may effect a substantial saving over the usual hand operations.

With good boilers, the right kind of pumping machine and the best kind of coal in stock for the purpose, there yet remains the continuous, all-important, every-day question of operations of fueling and of so conserving the fuel energy stored away in the coal as to utilize and transmit the same direct to the engine throttle in quantities as needed, rather than, as we too often observe, carried up the smoke stack only to be "wasted on the desert air." Fuel conservation is one of the most difficult of all perplexing problems confronting every power plant. Even the most careful firemen need every practicable facility with which we can surround them if the highest results are to be continuously maintained.

As aids in this work, involving as it does one of the most conspicuous items in operating costs, the best patterns of shaker and dumping grates, and also automatic damper regulators, may be used with profit. If the amount of coal consumed will not justify the purchase of a CO_2 recorder, a boiler efficiency meter with Orsat apparatus will be found to furnish a valuable guide.

Steam flow meters may be had at a small cost for attachment to the different steam lines, and when installed will furnish desirable information as to the amount of steam conveyed to the different units or heating systems. Another device of value, tho of much greater cost, is the Venturi meter, which, if placed on the pump discharge line as a check on the engine counter, will often reveal unsuspected pump slippages needing correction.

A common and often unconsidered source of loss in many small plants is leaky valves. A valve reseating machine should be in every power house and by its use every valve kept always in repair. Suitable equipments for the various repairs common to all plants from time to time are not only necessary but money-saving assets in times of their need.

Oiling arrangements frequently are not given the attention their importance would seem to deserve. The system employed should be such that the oils may be saved, refiltered and used again. With such saving they may be used more freely than otherwise, thus safeguarding against hot bearings from time to time with their consequent annoyance, or possible interruption to the service.

In connection with the operation of filtration systems a good serviceable laboratory would seem to be indispensable for the necessary tests. Cities without such systems and having water at times of questionable quality will find apparatus for the use of hypochlorite of lime to be inexpensive and of great value.

By the use of steam and water pressure-recording gages, if supplemented with accurate hourly notations of coal consumed and water pumped, the engineer and manager are afforded definite knowledge concerning the workings of the plant, and also furnished a permanent record of the same.

So well known is the value of the meter that it would seem to be superfluous to make mention of it here. And yet the fact remains that in Indiana there are a number of plants still operating almost, if not entirely, upon flat-rate basis. As a conserver of water this device is second to none, and its value is closely followed by the meter-testing machine. For leakage inspections in the distributing system the detectorphone and pitometer are both widely recommended.

For the office there are many devices worthy of adoption and use, such as the adding machine, the typewriter, addressograph, card indexes, filing apparatus, loose-leaf systems, etc. An accurate map showing definitely the location of all mains, valves and service boxes is of inestimable value and should be deemed an indispensable part of every system. A few well-selected technical books and the best waterworks journals will prove to be not only sources of information and pleasure but of actual profit as well. For articles of especial interest, should one wish to dispense with indexes, a scrapbook might be used to good purpose.

Treatment of Buffalo Water Supply with Chlorine Gas

Bids for furnishing and installing plants for treatment of the water supply of Buffalo, N. Y., by sterilization, were recently received by the city, and included one bid for a plant using hypochlorite of lime and two using chlorine gas, one applying the chlorine gas directly into the shaft at the intake pier and the other by first mixing it with water in tanks and applying the mixture into the shaft in the intake pier.

The following description of the two methods of applying the chlorine gas is taken from the report of Rudolph Hering upon the bids offered:

"There is no difference in the quality of the gas, but there is a difference in the mode of its application. In bid No. 1, made by Wallace & Tiernan Company ($3,300), the liquid chlorin gas is carried to about 40 feet below the lake level thru silver tubes and there released thru strainers made of carborundum, each to be four inches in diameter, so that the gas escapes vertically in myriads of minute globules over the central area of the shaft and gradually tends to ascend thru the downward flowing water until it is completely absorbed. While the globules tend to expand in their relative ascent, the greater velocity of the downward flowing water actually carries them down, reduces their size and increases the absorption under the increasing pressure. The conditions, therefore, appear favorable for a quick and thoro mixture and solution.

"In bid No. 2, made by Electro-Bleaching Gas Company ($3,325), the liquid chlorin gas is absorbed by a water spray within a tank resting over the shaft and discharged into the descending water 40 feet below lake level as a strong chlorin gas solution. Under otherwise equal conditions, as for instance under equal pressure, the absorption of gas by water is quicker, if water globules pass thru gas, as in bid No. 2, than if gas globules pass thru water and constantly diminish in size by absorption, as in bid No. 1. On the other hand, the absorption by the water will not be as rapid under atmospheric pressure (bid No. 2) as at a depth of 40 feet below the water surface (bid No. 1).

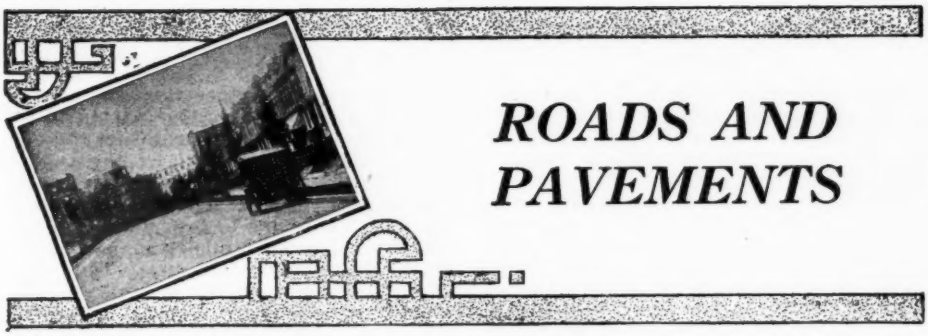
"In bid No. 2 the distribution of the chlorinated water is at six points from six arms about 2½ feet from the center line of the shaft, the discharge being horizontal and directed towards the periphery.

"I understand that a United States patent controls the absorption of the chlorin by water as applied in bid No. 2. I understand also that a United States patent controls the introduction of the liquid chlorin gas directly into the water as contemplated in bid No. 1. As regards the direct application of chlorin gas for sterilizing water, I am informed the patent was granted to Major Darnell, U. S. A.

"As regards the application of absorbed chlorin gas, it is stated, that this use has been made at colleges, notably at the Massachusetts Institute of Technology, some time before the patent was granted.

"I would suggest that your attorney examine into the validity of these patents, if thought advisable. The city should in both cases, of course, be protected in its contract against the additional payment of any royalty."

It may be added that chlorin gas was applied for the sterilization of sewage under Powers patents some twenty-five years ago.



ROADS AND PAVEMENTS

Melting Point Tests of Bituminous Materials

The test for melting point of bituminous materials was discussed before the American Association for the Advancement of Science by P. P. Sharples, chemist of the Barrett Manufacturing Company, and H. B. Pullar, consulting asphalt chemist, Detroit, Mich.

Mr. Pullar recounted the various methods of making the test of melting point and showed that the results obtained by one method are not comparable with those obtained by another. He prefers the cube method, recommended by a special committee on bituminous materials of the American Society of Civil Engineers and probably more generally used than any other. His second choice seems to be the ring and ball method used by a number of chemists, more extensively with tars than asphalts.

In his opinion, the melting point test, like other tests for bituminous materials, if properly used, is of considerable importance. The melting point test indicates in a large measure the lowest possible temperature at which a bituminous material must be heated before using; for instance, a blown oil product having a penetration of about 75 and having a melting point of 200 degrees F. will require heating to at least 350 degrees F. before using in a practical way, whereas an asphalt obtained by the direct distillation of oil having a penetration of 75 but a melting point of only 130 degrees F. would require a heat of not more than 250 degrees F. to 275 degrees F. to be the proper temperature for use, and at a higher heat would likely be injured.

The melting point also is of considerabel importance and value in identifying different bituminous materials or the different processes used in the production of these materials. This point is clearly brought out by Mr. Prevost Hubbard in his interpretation of the melting point test, which is as follows:

"A determination of the melting point of solid bitumens is mainly of value as a means of identification and for control work on the part of manufacturers. The melting point of a bitumen is directly related to its hardness and brittleness, but the relations are not the same for all classes. Thus, at normal temperature, a blown oil with a melting point of 50 degrees Centigrade is neither hard nor brittle, while a tar pitch is both. As the melting point rises, however, they both become harder and more brittle. The climate under which a bitumen is to serve as a road binder should be considered in connection with its melting point, and this is particularly true of tar products."

It must, however, be understood that the results obtained at the present time with this test are not comparable with the results obtained even a few years ago, and that in all cases where the melting point is given, the method of testing should be indicated.

Mr. Sharples shows the dependence of the viscosity of tars upon their melting points, with many apparent discrepancies in the tables of results given. He eliminates some discrepancies by using a standard method of testing, and suggests that others can be eliminated by taking more careful consideration of temperatures and the varying changes in viscosity of various materials with changes in temperature. The effect of free carbon on the relation between melting point and viscosity is shown in one table to be very marked. His conclusions are that the viscosity of tars of the same composition varies with the melting point, but not in a direct ratio and that in tars of the same melting point, but differing in free carbon content, the viscosity increases with the amount of free carbon.

Mr. Sharples thinks the inclusion of tests of melting point and viscosity in the physical examination of tars to be used as binders is warranted. One application of the information obtained regarding viscosity at 100 degrees C., as compared with the melting point, is as an indication of the behavior of the tar as to ease of securing uniformity of distribution and again as an indication of resistance to temperature changes when in place in the road wearing surface.

Concrete Road Construction in Indiana

The accompanying cut is a photograph of the concrete mixer at work on a one-course concrete roadway on the Elliston grade west of Bloomfield, Greene County, Indiana.

This road has an 18-foot driveway, concrete eight inches thick in the center and six inches at the edges, placed on a flat subgrade rolled with a 12-ton roller. The length of the contract is 4,636 feet.

The concrete is one part cement, two parts sand and three parts washed and screened gravel. Steel reinforcing triangular wire mesh was used, placed 2½ inches from the surface of the concrete. Baker joint protection plates and Elastite filler were used in ⅜-inch joints.

Water was furnished thru a mile of 2-inch pipe, connecting with a Bloomfield city hydrant. Sand came from a White River bar at Elliston and washed gravel was furnished by the Merom Sand and Gravel Company, at Merom, Ind. The mixer used was furnished by the Koehring Machine Company, Milwaukee, Wis.

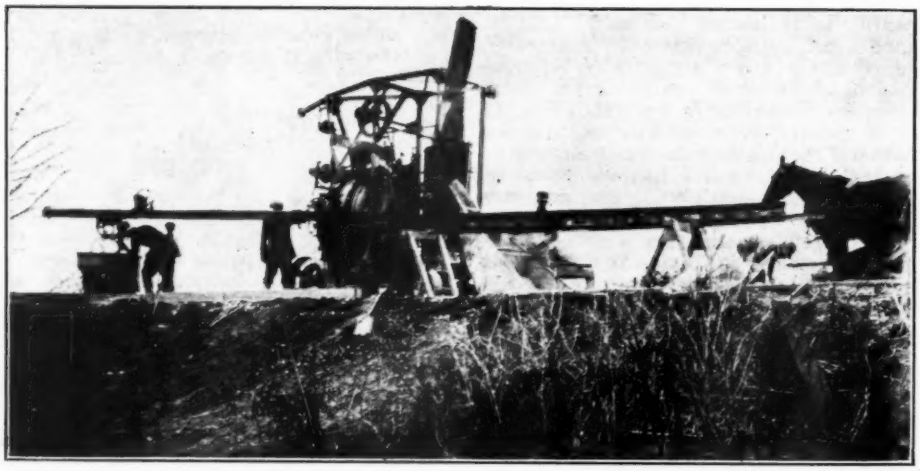
The road was constructed by the county by day labor under Superintendent Frank Leavitt, of Bloomfield, Ind., at a cost of $1.45 per square yard, including grading. As shown by the photograph, the fill is rather deep and the hauling of materials was therefore quite high in cost. The grading cost 22 cents a square yard, leaving the road paving proper to cost $1.23. The road was opened to traffic in December, 1913.

CONCRETE MIXER *delivering concrete for base of brick pavement on the Elliston grade west of Bloomfield, Ind.*

Brick Pavements as an Investment

By W. T. Blackburn, C. E., Paris, Ill.

If you could convince the general taxpayer that for every dollar expended he would receive two, then loan him the one and guarantee the return of the two, I feel sure that he would accept the opportunity, and yet that seems to be the opportunity presented to the public, and the farmer and truck-gardener in particular, in the brick-paved highway. The little that the brick roads would cost you personally amounts to nothing compared with the amount that such roads would add to your yearly income, increase the value of your farm, and add in an untold measure to the happiness of your family. It has been estimated that 90 per cent of the criminals in the land originate in the city. You are spending immense sums for the building of court houses, jails and state prisons. If like sums should be spent in the improvement of your country highways and the general development of the resources of your country, giving employment to the unemployed in building of the splendid brick highways, instead of providing means for the employment of criminals from the prison, had we not better provide such employment as to eliminate the despondency of fathers and mothers and the discontent of the sons and daughters at the end of a mud road, by spending, if need be, greater sums in beautifying the lives and interest of the rural districts, thus reducing to the minimum the population of our asylums and prisons and making an investment that would do more for the uplifting of humanity than could be done if one-half of the wealth of the nation were spent in the persecution and confinement in prison of all the criminal classes. Invest your



money in eliminating the criminals rather than in their punishment.

As to your yearly income and increase in value of your farm lands, the following facts may help to make clear to you. I recently observed the revenue from two separate farms of 320 acres each, located in the corn belt of Illinois; one at the end of a four-mile brick-paved road, the other at the end of a four-mile mud road. These farms should produce under the ordinary rotation of crops annually 280 tons of corn, 80 tons of oats and 120 tons of hay, or 480 tons in the aggregate, to be delivered over four miles of roadway. On the brick road there has been delivered eleven tons of grain in one trip by one team, using five wagons, while on the earth road two tons were all that could be delivered by a similar team. The haul being four miles in both cases, and as they could make three trips a day, twenty-four miles team travel, the team on the earth road could deliver six tons per day at a cost for team and wagon of $4.50, thus making a cost of 75 cents per ton for the four-mile haul. On the brick road the delivery was 33 tons per day at a cost of 19.7 cents per ton on a four-mile haul. A difference of 55 cents per ton in the cost of delivery in favor of the brick road, or a difference in cost of $264 on the 480 tons delivered. This is only a small per cent of the actual loss to the farmer living on the earth road, as he has had to sell his grain at a time when the roads were in condition, without regard to the price of his product. From actual experience it has been demonstrated that this would represent a loss of $1.50 per ton on corn, $2.50 per ton on oats and $5 per ton on his hay, making a loss in the aggregate of $920 on account of not being able to deliver at the best market price. This with the loss in cost of delivering, makes $1,184, or 10 per cent on an investment of $11,840, an increase in value of $36 per acre on his 320-acre farm. This represents the investment in a nine-foot brick highway that has cost the tax payers of the township $10,000 a mile, or, if all of the principal highways of the township could be improved, would only represent a tax on all of the property of $10 per acre. These brick roads are not a liability—they are an asset. They don't cost you money—they make you money. It isn't a question of whether you can afford brick roads—the question is, how can you get money enough together to do without them. Bad roads cost like the mischief. The most expensive road is the one you cannot use.

The cost of a brick road 10 feet in width at $1,100 per foot in width per mile as compared with roads being built of other materials at a cost of $550 per foot in width per mile at the end of a twenty-year period has been demonstrated to be less expensive after adding to the original cost in each instance 5 per cent on original cost, together with the maintenance in either case for the twenty-year period. This does not take into account the expense and inconvenience due to the repairs and resurfacing of the cheaper roadway, nor does it give credit to the brick road for being in a serviceable condition at all times for the twenty-year period. Many brick streets are today in perfect condition that have withstood the traffic and the effect of the elements for more than twenty years.

The term permanent roadway is often misapplied. However, it has been said by a prominent authority that "the life of a well-constructed brick pavement cannot be estimated with any great degree of exactness; first, because the traffic conditions are constantly changing, and, second, because no brick pavement which has been constructed in accordance with the best modern practice has yet worn out. The amount of wear sustained by given pavements during comparatively long periods of years has been determined in several instances, but has usually been so small as to make the probable term of service appear almost indefinite." From such evidence we may conclude that the properly constructed brick road is entitled to a life of twenty years without repair, or a period long enough to allow us to forget that the original construction ever cost anything. The original cost is as far as many of us can see. Benefits are too seldom looked into. We are inclined to complain of taxation as a burden instead of a blessing, and the real foundation of our civilization.

The greatest assets of the most substantial nature are transportation and agriculture. Neither can be fully developed without the other.

The total tonnage drawn over the highway at this time may be quite small, but upon the improvement and development of the road and the resources of the country, the tonnage may be increased many times. While the requirements of today may be only ten to twenty tons, these improved conditions have caused this road to become a main highway, with from two hundred to three hundred vehicles per day, many of them three to six ton trucks. Not only should the improvement be made to care for the present traffic, but should be improved to provide for a far greater traffic, not only in the number of vehicles, but the character of the vehicles. The traffic which was once only local, confined to teams from a few of the neighboring towns and villages, has become interstate, and almost national in character.

The Principles of Scientific Management as Applied to Highway Engineering

By Frank B. Gilbreth, Consulting Engineer, New York City.

From a lecture delivered by Professor J. Ansel Brooks of Brown University before the graduate students in highway engineering at Columbia University on March 2, 1914.

It is a fortunate thing for engineers that from its very start scientific management has been understood to apply to the work of the engineer. It has been the custom for some years to associate the science of management especially with shop work and to believe that its principles are most successfully applied in manufacturing, but, as the breadth of the field of application of the principles of scientific management has become better understood, it has been realized that there is no field of activity to which the principles do not apply and that there is no type of work, office work, shop work, field work, manufacturing, constructing, selling, advertising, etc., which cannot be done better, if the theory of scientific management is understood and the practice of scientific management is applied. You, as engineers, recognize, then, that scientific management, starting in the engineering field must have a particular claim upon your attention and that you, as specialists, must translate its terms into your own vocabulary and apply them in your own field.

My task tonight is to outline for you these underlying principles of the science of management, leaving it to you to apply them to your own type of work. I can, perhaps, the better do this as your work is closely allied to work at which I spent many years of my life, construction work.

The principles of scientific management have been defined by Mr. Taylor in his book of that name as four:

1. A development of a science for each element of a man's work, which replaces the old rule of thumb method.
2. Scientific selection and training of the workmen.
3. Hearty co-operation between management and men.
4. An almost equal division of the work and the responsibility between the management and the workmen.

This order is that of the development of the science of management. For purposes of installation we might change the order a little, and say that we are to do four things:

1. To functionalize the work so that each member of the organization does that part of the work that he is best fitted to do.
2. To inculcate that spirit of co-operation that will make each member willing to do the work that is assigned to him.
3. To standardize.
4. To teach each member of the organization so that he can best perform his part of the work.

Our functional chart illustrates how the work is divided. This contains ten circles, five above and five below a horizontal line. This horizontal line is the line that divides the planning from the performing. The five circles above represent the divisions of the planning department and the five circles below the divisions of the performing department. Each of the ten circles represents a division of work and responsibility. Each circle of the ten is connected with every other circle, showing the inter-relation of the work and the inter-responsibility of the individuals doing it. Under each one of these divisions or functions of the work come sub-functions which are made on the same basis, that is, that each division shall cover the work which can best be done by a certain type of man, or, putting the emphasis on the human element, that each division shall provide the most suitable work possible for a certain type of man. The names of these various divisions symbolize more or less successfully the type of work which is to be done. If you are acquainted, as I presume you are, with the literature on the subject, it will not be necessary for me to go into any detail in describing the work of these various functional foremen. The worker, who might perhaps better be placed in the top than in the bottom circle, is helped and taught by each one of the functional foremen, who is a specialist teacher as well as a specialist worker. He occupies the position of a worker only as long as he is so untrained or so satisfied with that position that it is best for him to remain there. The moment he acquires enough training or enough desire to become a specialist, he is promoted into one of the functions, where there is a constant demand for trained men. The first thing you must do, then, is, upon paper at least, to lay out the functional chart of your particular line of work, and to visualize which of your men will best fit into the various positions.

Along with this you want to visualize your plant, or whatever your work place is. This we do by means of a route model, which is simply a small three-dimensional representation of the work place and the various parts of the working equipment, movable and immovable. The advantageous thing about this model is that the movable parts can be shifted as changes are planned or made, and the en-

tire problem presented in a shape in which it can be seen and handled. Besides the route model we use a pin plan, and various other devices for moving the various parts as changes are made.

Having thoroly laid out the problem on the human side and on the material side, and laid out a method of attack to the desired result, it is necessary, before actually making any changes, to insure the hearty co-operation of every member of the organization. This is done by various methods.

1. By an educational campaign, by explaining so far as is desirable and desired the entire plan of scientific management and the plan of application to the line of work attempted.

2. By beginning the actual work so far as is possible on the management side. This for two reasons.

(1) The management side in the majority of cases needs the work most.

(2) The men will be much more willing to have the system applied to them, if they see it being applied to the management.

Co-operation, once secured, can be held by seeing that every step is made in the open and by seeing that every man receives a suitable, prompt, assured reward for everything that he does.

Having laid out your plant and secured the co-operation of your men, it is necessary to standardize. Standardization consists of two parts:

1. Securing a standard.
2. Applying the standard.

I will consider the application of the standards first as the subject is less technical, and as so many standards have been already established that you will be able to apply the result of the work of others in many cases before finding it necessary to take the actual measurements and find the actual standards for yourself. Devices, while they must in no way be confounded with the science of management, are excellent in applying the principles of standardization. According to the rule just given, that work should be done on the management side first, a few office standards may be easily established which will help the management and office force to visualize the problem of standardization. In themselves these devices are nothing; as showing the importance of the principle of standardization, they mean a great deal.

The cross-sectioned desk with its standardized equipment, and the arrangement of the various drawers for the various types of work will not only interest everyone about the plant, but will so substantially cut down the work of all using them as to insure sympathy with as well as interest in the work. More than this, in our personal experience they have inculcated a spirit of "thinking in least motions," a better method of attack, which has proved a most valuable asset. This same spirit has been the result of the installation of standard devices in the shop.

The bulletin board applies both to the planning and the performing department, the tool room, thhe tool stand and the assembling packet. The bulletin board is universal in its field of application. There is no one in the organization whose work may not be handled on the bulletin board. It thus serves as a unifying point as well as a standard method of handling work.

The tool room, while actually operated by but a few men, affects the work of the entire performing department and is an admirable object lesson as to the benefits of standardization. The assembly packet, while invented to cut down the motions of the assembler of a braider, illustrates a principle of so placing material that it can be handled with the greatest ease that is, as you can readily see, applicable to every type of work.

We will turn next to the derivation of these standards. They are the result of that accurate measurement that gives management its claim to be a true science. The methods of measurement, as you know, are time-study and motion-study. Time-study, the wonderful work of Dr. Frederick Winslow Taylor, upon which the science of measurement hangs, is a determination of the elementary unit times necessary to perform an operation. Motion-study is the determination of the proper elements to be timed. The two are parts of one whole, i. e., accurate measurement. This measurement may be done by a stop-watch or a set of stop-watches. It may be done with a cross-sectioned background, a clock and a motion picture machine. It may be done by means of the chronocyclegraph apparatus.

Lastly, but not least in importance, we come to the training or teaching of the men. This is done directly, thru instruction cards and thru the functional foremen, who are all specialist teachers, and indirectly, as you have doubtless noted in following this talk, thru the installation of scientific management itself. Everyone in the entire organization, management and men alike, if the installation has been properly done, becomes interested in the science of management and in the method of attack which it employs. This interest is the greatest educative force in scientific management, and, if you develop this interest in the subject, the application of the principles of the science of management to your specialty, highway engineering, is bound to result not only in success to you individually but to the profession to which you devote your lives.

Permanent Road Construction in the United States

Evidences increase that the need of more durable roads is beginning to be better appreciated by highway authorities. Commissioner Carlisle, of the New York State Highway Commission, plans for the construction of a largely increased mileage of brick and concrete roads.

In order to lessen the cost of brick, on which transportation charges are heavy when they have to be hauled long distances from other states, it is proposed to establish a brickmaking plant, to be operated by state convicts. A change in the maintenance system for macadam and bituminous roads is also contemplated. This consists in substituting for the present inefficient patrol system a gang system, each of the nine divisions of the state road system maintaining a repair crew provided with a portable repair outfit. This outfit consists of a motor truck or tractor designed especially to carry all the necessary equipment for making extensive repairs to bituminous macadam, as well as to water-bound macadam roads. Altho designed for a speed of fifteen miles an hour, the truck can be used as a road roller.

Another project of the commissioner is to assign a competent engineer to constantly investigate and study the most advanced methods and materials for road building in the different states, to insure that the many millions of dollars voted for highway improvement in New York are expended most judiciously.

Altho much progress has been made in the Middle West and far West in the building of cement-concrete roads, the East has only begun to experiment with this type. According to reports from some of the cement companies, about four miles of concrete road are soon to be built near Albany, and several miles will be built in Bergen county, New Jersey, on the Tea Neck and Fort Lee turnpikes. Numerous short pieces of experimental concrete road have been built in New Jersey, or are practically certain to be built in 1914. These are located at Glen Ridge, South Orange, Palisades Park, Red Bank and a stretch between Morristown and Dover. These are all near New York City and carry a large volume of mixed traffic. They are of the one-course type, like the Wayne county roads around Detroit, with no wearing coat on the surface.

Dr. Pritchard, chairman of the good roads committee of the Winona County Chamber of Commerce, at Winona, Minn., is authority for the statement that sixteen miles of concrete roads built in that county cost from $500 to $1,000 less per mile than bids on water-bound macadam roads in the same location. The actual average cost was $7,270 a mile for roads having a concrete surface 8 feet wide and 6 inches thick, with 6-foot shoulders of macadam on either side. Traffic is small in volume there, so that the 8-foot concrete surface is wide enough so long as there are good hard shoulders for turning out. The cost quoted includes preparation of the sub-base, culverts and all expenses except bridges. The higher bids for all-macadam roads were due to the distance that crushed stone has to be hauled, whereas clean gravel is used for the concrete.

Austin B. Fletcher, state highway engineer for California, reports that the California Highway Commission has adopted for a large portion of the 2,760 miles of trunk highways to be built under an $18,000,000 bond issue, a pavement having a portland cement concrete base not less than 4 inches thick and 15 feet wide, with 3-foot shoulders on either side. The concrete is covered with a wearing coat of stone screenings and asphaltic oil ⅜ to ½ inch thick. No expansion joints are provided, but when natural cracks occur, which they usually do at intervals of about 30 feet, they are filled with heavy bituminous material.

Nearly 200 miles of these roads have been built or contracted for, at an average cost of $6,394 per mile, exclusive of the cost of grading, culverts and administration. Bituminous macadam roads built by the commission cost $6,364 per mile and water-bound macadam $4,303. Asphalt on a macadam base costs $8,403 a mile, but roads of this construction are wider, so that the cost per square yard is practically the same as for concrete—71.6 cents, as compared with 71.2 cents. Bituminous macadam is 72.3 cents a yard and ordinary macadam 48.9 cents.

The report of the Illinois Highway Commission for the years 1910 to 1912, inclusive, gives some interesting data on the cost of construction of macadam and concrete roads, exclusive of contractors' profits, compiled from actual costs of 150 pieces of macadam road and five pieces of concrete road. The costs include shaping the roadbed and trimming the shoulders, figured in all cases at 3 cents per square yard. The construction costs may be compared as follows:

STANDARD 16-FOOT SURFACE.

Average haul of crushed stone, gravel and cement, 1.6 miles.

Water-bound macadam, 16 feet wide	$6,269
Bituminous macadam, 16 feet wide.	7,985
Concrete, 10-foot concrete with 6-foot macadam	7,982
Concrete, 12-foot concrete with 4-foot macadam	8,402

Concrete, 16-foot concrete surface,
6 inches thick.....10,061
Concrete, 16-foot concrete surface,
7 inches thick.....11,472

It will be seen from this that a 10-foot concrete road with a 3-foot macadam shoulder on either side, or 6 feet on one side, costs less than an all-bituminous road of the same width, and only $1,713 a mile more than a 16-foot water-bound macadam road, while a 12-foot concrete road with 4 feet of macadam costs only one-third more than ordinary macadam 16 feet wide, and only $417 a mile more than bituminous macadam.

An elaborate traffic census taken by the State Highway Commission of Massachusetts shows that more than 63 per cent. of all the traffic on the state roads was self-propelled in 1912. Former Highway Commissioner Macdonald, of Connecticut, says that 65 per cent. of the travel in the Nutmeg State is by motor vehicle, and Commissioner Johnson, of Illinois, shows by a traffic census covering many of the roads of that state for the last six years that motor traffic has increased in various places from 2 and 4 per cent. in 1907 to 33, 50, 58, 63, and 66 per cent. in 1912. These percentages are averages of observations taken four days each in May, June, August and September. Commenting on these figures, the commissioner writes, in his fourth report to the Governor, recently issued:

"The conclusion can be drawn that any plan for systematic road work in many parts of the state must consider that a large majority of the traffic of the future will be motor traffic. In particular, there is a vast field for the development of motor truck traffic, a class of traffic that it has not been necessary heretofore to consider in plans for road improvement. It is believed that in many sections of the state the opportunity is big for the ultimate development of this class of traffic, and provision should be made in the future road building on a majority of the main roads for the 8 and 10-ton motor truck."

Prison Labor on Roads

The American Automobile Association is heartily in favor of the use of convicts in road work, as is evidenced by the following report from its National Committee on Prison Labor:

"Road building by convicts has stood the test of scientific investigation made for Columbia University, thru its graduate highway department, by Sidney Wilmot, a road engineer, recently an advanced student in that university, and attached to the staff of the National Committee on Prison Labor, which is also located at the university.

"The investigation into the costs of convict labor on the roads emphasizes clearly the economic advantage secured by this joining of the problem of the convict and the road. This advantage reverts to the taxpayer and also to the convict's family thru the wage which can be paid for his labor.

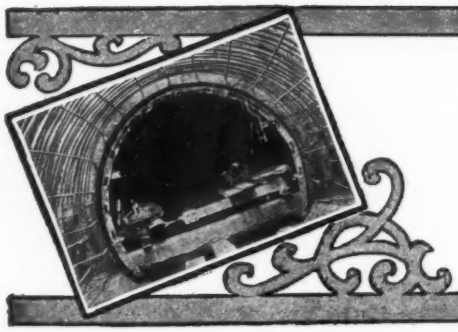
"The Academy of Political Science has undertaken to make this study available because of its broad social and political significance. When each state and county is engaged, as at present, in the reorganization of its prison system, and is endeavoring to do away with the crude methods of torture, scientific methods of successfully employing the convicts with advantage to all parties become of public interest.

"The findings of the investigation show that the work performed by the convicts in the different states ranges in value from $1.50 to $5.70 per day, with a profit to the state by the use of this labor of from 50 cents to $4.03 per day. In short, the contention is well sustained that there is a general and considerable profit at present going to the state by the use of convict labor for road work over the cost by other methods of construction, this saving being quite independent of locality and types of construction, altho influenced by the size of the gang used.

"An interesting feature of the study is the comparison of the cost of subsistence and of guarding. The average cost of subsistence is found to be 40 cents per man per day; while the expenditure for guarding in those cases where costs could be secured averaged 48 2-5 cents. Striking thing of these figures is that the expense of guarding adds to the cost of the work over 20 per cent. more than that of feeding. This throws into prominence the economic advantage of the "honor system." This substitution of a man's word and his conscience for a gun was, at the first, a makeshift, but has since become a necessity—a saving in every sense of the word.

"The prison and the highway departments should have joint supervision over this work; the representatives of the prison department having charge of the men and acting as foremen, while the engineers of the highway department are responsible for the construction work. This joint supervision has been found, according to the experience of the different states, to yield the most satisfactory results.

"The prisoner himself benefits most of all by his work on the roads. The healthful outdoor labor, the better food, the incentive of the honor system, and, above all, the wage increasing in proportion to the profits of the state, all combine to make him better fitted to re-enter society."



SANITATION

Disinfection of Sewage and its Success in a Small City

By Frank A. Nikirk, Consulting Engineer, San Jose, Cal.

This brief description of a system of disinfecting the effluent from an unsuccessful septic tank shows the difficulties in handling the plant satisfactorily and the simplicity of the plant required. It is from an address to the California League of Municipalities in response to a request for information on this subject.

THE College Park sanitary district which lies adjacent to the City of San Jose, Cal., was organized in 1905. The boundaries of the district were extended in 1907 to include Hanchett Park, an exclusive residential district, and now include an area of about 2.6 square miles. At present the population of the district is slightly over 2,000.

As originally constructed, the sewage disposal works consisted of a septic tank and two filter beds. The plant is located on the bank of the Guadalupe Creek, into which the effluent of the filters was conducted. The filters were built in a natural excavation; about two feet of creek gravel was placed in this. The filters were approximately 340 feet long; one was 12 and the other was 15 feet wide.

The beds were not underdrained; for this reason and also the lack of depth of the filtering material, they were never very satisfactory. They were early abandoned and the effluent of the septic tank was discharged directly into the creek.

When water was plentiful in the Guadalupe Creek this effluent was not a nuisance. For the past two years, however, there have been no freshets to cleanse the channel, the growth of vegetation has been very rank and the amount of water flowing in the creek has been far below normal.

Under these conditions, with the water in the Guadalupe containing a relatively low percentage of dissolved oxygen, it can be readily seen that conditions are not very favorable for the disposal of sewage by dilution. The growth of vegetation checks the tendency toward re-aeration, and an unsanitary condition is apt to exist.

Under such circumstances it became necessary to treat the effluent of the septic tank before discharging it into the creek, therefore a temporary plant for treatment with chloride of lime was installed while the present plant was being constructed.

A treatment plant of this type requires a supply of water with which to mix the chloride of lime; consequently a windmill and tank were constructed over a well that existed at the end of the septic tank. The hypochlorite apparatus was located in the tank frame, which was inclosed to protect the plant from outside interference, as a constant and uniform action is required.

The apparatus consists of a mixing tank and two storage tanks, each holding about 275 gallons, and a fourth tank, in which are located the devices for regulating the flow. The tanks are arranged so that the flow is by gravity thruout the entire plant. Each tank is provided with an outlet thru which to draw the solids that settle out of the solution.

The chloride of lime is put into the mixing tank and the tank filled with water. During the filling the solution is thoroly mixed. The stirring device consists of a sort of propeller on a shaft, suspended from the top of the mixing tank. The shaft is revolved by a ratchet device operated by moving a lever backward and forward.

After mixing, the solution is allowed to stand sufficiently long to let the greater portion of the suspended matter settle. The clear liquid is then drawn off into the storage tanks thru an outlet six inches above the bottom, so as not to disturb the settled solids. More water is then turned into the mixing tank and the insoluble residue is stirred up and flushed into the outlet sewer. The operation is then repeated.

At the College Park plant three "batches" are mixed each morning for a twenty-four hour run. The third "batch" is drawn slowly from the mixing tank and into the storage tanks as the latter are being emptied. This method was adopted in order to use the maximum quantity of water, the greater flow being more easily regulated.

In small installations, irregular flow of the solution is common, due to the clogging of the measuring orifice by imperfectly settled solutions, or by flakes of calcium carbonate being formed in the solution tank by the absorption of carbon dioxide from the air.

In this particular installation the solution flows from the storage tanks to the regulation tank and is controlled by a float valve which keeps the liquid in the latter at a constant height. In the regulation tank is a half-inch brass tube extending from above the surface of the liquid down thru a large rubber stopper in the bottom of the tank. In the side of the tube is a three-sixteenth-inch hole which admits the solution. The rate of flow depends upon the head of water upon the orifice, and the desired rate may be obtained by raising or lowering the tube through the rubber stopper in the bottom of the tank.

From this tank the solution is carried thru a four-inch vitrified pipe line to the outfall sewer, where it mixes with the effluent of the septic tank.

The sterilizing action of chloride of lime is very ably set forth by Professor Charles Gilman Hyde in a paper presented before the fourteenth annual convention of the League of California Municipalities at Santa Barbara in 1911 and entitled, "The Sterilization of Water Supplies by the Use of Hypochlorites." While Professor Hyde's paper refers particularly to the protection of water supplies, the action of hypochlorites is analogous in the purification of water supplies and sewage effluents. In both cases hypochlorous acid is formed, which gives up its oxygen in the presence of organic matter.

In designing disinfecting apparatus one of the important factors to be dealt with is the fact that calcium hypochlorite exerts a very strong corrosive action upon wood and most metals. In some cases the tanks are lined with cement mortar laid on metal lath; in others a resistant paint is used. The pipes should be well galvanized and the valves should be bronze. The plant should be well ventilated, as the dust arising when the drums of chloride are opened, and during the making of the solution, is very irritating to the eyes and the membranes of the head.

Grades and Leakage in Intercepting Sewers

In a paper before the American Association for the Advancement of Science, J. N. Ambler, C. E., Winston-Salem, N. C., discusses the design and construction of intercepting sewers and their appurtenances. In that paper he has the following to say regarding the difficult questions of grades and construction of watertight sewers, which is based upon his extensive practical experience:

In spite of the view of many authorities that extremely flat grades are practicable, in sewers of this kind, because of the greater flow, and the fact that the sewage has become thoroly macerated by the time it reaches the intercepter, the writer is thoroly imbued with the belief that all the fall available should be obtained. This belief rests on his experience in cleaning out intercepting sewers after having been in use, and, of course, neglected, for many years.

All the sand, mud and illegitimate matter of all kinds which gets into the various closets, or thru the manholes in the streets, is pushed down the sewers of sharper grade, and finds a resting place in the intercepter.

The writer once removed some twelve or fifteen hundred bushels of such substances from about half a mile of old intercepter. Most of this was sand, but bottles, rags, straw hats, overalls, stones, wooden articles, etc., were also present, and the capacity of the sewer was greatly reduced.

Of course, hard and fast rules cannot be laid down, but the writer does not feel good in laying a grade as flat as 1 foot per 1,000. It is his endeavor, in the light of experience with cleaning, to get all fall possible.

From the very nature of the low, level intercepter, it is usually located where the ground is alluvial, and with the ground water level near the surface.

In many cases the ground to be traversed is marshy, and in nearly every instance the sewer is laid below ground water level.

These conditions are distinctive for the style of work and require special methods of treatment.

Unless the joints are laid very perfect, and so maintained at the flat grade as to utilize all the fall, without pockets, the infiltration of ground water will be so great as to greatly reduce the carrying capacity of the sewer, or even, in the case of a long line, to completely destroy its usefulness.

Settling of the joints will, of course, render the conditions worse, and may result in the inflow of quicksand until the sewer is put out of commission, as in a

case which once came under the writer's charge for correction.

It is, therefore, of the utmost importance, not only to have perfect joints, reducing the inflow of the ground water to a minimum, but also to provide means to maintain the grade as a perfectly straight and rigid barrel, free from settlement.

The difficulties of meeting this last requirement are often very great, as usually the bottom of the trench is a water-soaked quagmire and frequently quicksand.

Considering, first, the question of perfection in the joints, the writer has specified a mortar of neat portland cement, on account of its density and imperviousness.

The shrinkage of neat cement mortar being considerable after the mortar is set, a wash of thick grout is used to fill the cracks.

The entire circumference of each joint is rigidly inspected by hand, and no imperfect joint is left on the work.

Special compounds, as melted sulphur, and the various elastic compounds from which it is claimed that perfect joints may be made, even in water, were not tried, either on account of the expense, or because there was doubt felt as to the durability of such substances.

Feeling the necessity of having some criterion upon which to base the engineer's acceptance of the work, so far as ground water is concerned, the writer read up all available data on ground water flows, and came to the conclusion that it is a subject about which too little is known, and what is known is conflicting.

There should, however, be some criterion to apply to work done by contract, and it seemed that nothing better could be done than to determine how much water the sewer might be allowed to carry without materially injuring its usefulness. The criterion should not be so severe as to greatly affect contractor's bids.

Such a criterion, it would seem, should be based upon the number and circumference of the joints.

The following clause appears in one of the writer's specifications, and is offered for what it is worth, until something better can be substituted. It, at least, has had the effect of securing some very careful work, and contractors were not disposed to regard it as severe when thoroughly explained to them.

The clause is as follows:

"It is the intent of these specifications that no more leakage of ground water into the sewer be allowed than is admissible with a first-class piece of work, in which care has been exercised to get as near as possible to a water-tight result.

"To determine the admissible amount of leakage, the length of a joint will be considered as the outside circumference of the spigot end of a pipe.

"Leakage not in excess of two gallons per day of 24 hours for each foot of circumference of every joint will be considered admissible, the amount of flow to be determined by the engineer's gaging in each section, by means of a notch board.

"The contractor agrees that for each 10,000 gallons per day of 24 hours by which the total flow of the sewer exceeds what the total flow should be, when figured on the basis already given, a deduction of $100 from the contract price will be made.

"This will not apply further than to a total flow resulting from three gallons per day of 24 hours, from each foot of joint length, beyond which figure the sewer will be regarded as not in compliance with this contract."

The writer's opinion is that the above requirement is a very mild one, as he once laid a mile of large sewer thru exceedingly swampy land, passing under several streams, etc., with a result that not more than a stream one-fourth inch deep was flowing in the bottom of the pipe at the lower end on completion.

However mild the criterion may be, it has had a powerful deterrent effect against bad work.

It is extremely important that the manholes should not leak. To prevent this, the best hard bricks are used, each being dipped in a pail of water, as handed to the mason.

The brick work rests on a cement bottom 12 inches thick, with a solid cement invert and the contact of the pipe with the masonry is an object of especial care.

Manholes are built up sufficiently high above the meadow to prevent being stopped by floods.

The caps are secured to the covers by two set screws to prevent malicious persons from placing foreign substances in the sewer.

The handling of water in the trench during construction is usually less serious than the inexperienced are apt to imagine. A diaphragm pump connected to a small gasoline engine is the cheapest and best way known to the writer for removing the water. A small trench is excavated along the side wall of the main trench which conducts all accumulated water to a pump, where it is promptly removed by pumps, without being allowed to rise on the freshly constructed sewer line.

The writer has used the pile and platform method of founding, and finds it of very general application, of moderate cost to handle, and very satisfactory in result.

Two piles, 4 by 4 inches, bluntly sharpened, are driven opposite each other in the trench.

Two more piles are driven at a distance of 2½ feet up the trench, and so on, wherever a thoroly firm bearing for the sewer cannot be found.

Across the heads of these piles a 1 by 4-inch batten is spiked, and a platform of two 1½-inch planks is laid on and spiked to the various battens over each pair of piles.

Piles are driven to practical refusal by means of a rammer, consisting of a cast iron disc 8 inches in diameter, 3 inches thick, into the center of which a 2-inch iron rod is screwed. This makes a very heavy rammer, resembling the piston rod and head of a steam engine. It takes three or four strong men to operate it, but it is the quickest and most economical way the writer has been able to find for this work.

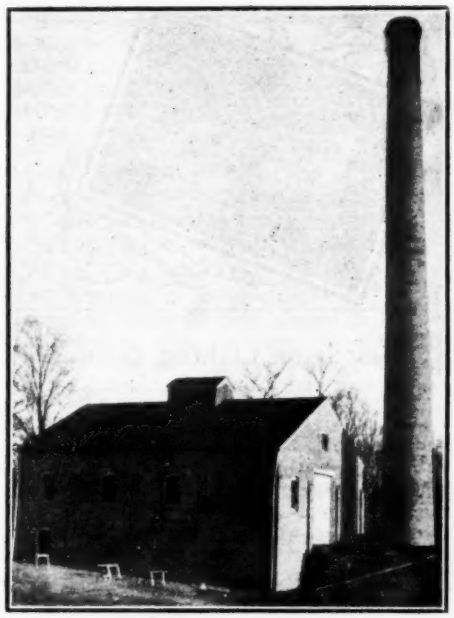
The piles vary in length from 18 inches to 9 feet. Even where the short ones are used, the ground being tolerably firm, a far superior foundation results than is to be had by laying loose planks in the bottom of the trench.

The platform was laid to a more or less regular grade about 3/10 of a foot below the flow grade of the sewer, the pipe being supported in a cradle of two wedges cut from 1½-inch plank, and driven under the pipe from opposite sides until the flow line was precisely at grade.

The wedges were then spiked to the platform to hold them in position, and about half a gallon of concrete was placed behind them to prevent a tendency for the back-fill to crush the pipe.

Garbage Disposal at Erie, Pa.

After many months of difficulty over the location of its new garbage incineration plant the city of Erie, Pa., finally located it several miles outside the city on a farm purchased as a site. The plant was completed and fires were started in the furnaces October 16, 1913, and, beginning on the 18th from 10 to 20 wagonloads of garbage were delivered to the plant daily and disposed of in 3 to 5 hours. After the 2 months of operation by the contractor, provided for in the contract, a test was called for under the contract. The city has 20 garbage wagons and 40 wagon bodies so that but 20 are available for collection at one time and the same number for transportation on train to the incinerator. There is but one train a day on this branch of the Pennsylvania railroad which will take the garbage to the plant so only 20 loads a day can be delivered. The contract calls for a test on a 3 days' run at about 0.6 the capacity of the plant or more, so that the city has not been able to supply enough garbage for the test run.



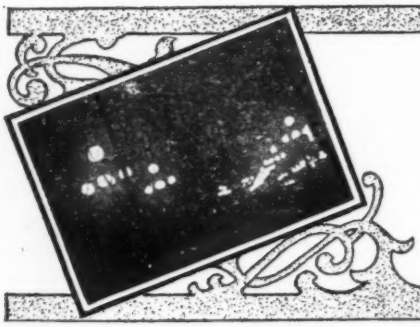
MORSE-BOULGER *garbage incinerator at Erie, Pa.*

By saving garbage for two days, 40 loads were burned one day, starting with a cold furnace at 8 o'clock in the morning and burning 27¼ tons of garbage completely by 6 p. m., by the use of 3,600 pounds of coal.

As the contract calls for the drivers unloading their own loads, half the wages of the man at the top was charged to the cost of disposing of the garbage. Two men at the furnaces below were charged in full. The cost for this run from cold furnace to start with for labor as above and coal was 33 cents a ton, apparently a low figure under the circumstances, and the further fact that only garbage has been delivered to the plant, tho the contract provides for the delivery of a mixture of garbage with one-fifth of combustible miscellaneous waste, which would furnish almost enough fuel to burn the garbage.

The board of health has prescribed wrapping garbage in paper before depositing it in the cans and a large proportion of the garbage is so wrapped, but the paper is wet and the amount is small in proportion so that it is practically as hard to burn as the garbage is.

The Morse-Boulger Company, New York, were the builders of the plant.



Lighting

New Street Lighting Contract in Indianapolis, Ind.

The city of Indianapolis, Ind., received bids on April 20 for its street lighting for ten years, beginning April 1, 1915, on all-night schedule upon full specifications prepared by B. J. T. Jeup, city engineer. The contract was open practically only to the two electric light companies doing business in Indianapolis, and bids were received from both of them.

The specifications provide that the minimum number of arc lights shall be 2,000 and of incandescent lights, single or in clusters, 500; that preparations shall be begun at once and the entire plant be ready to begin use on April 1, 1915, with a forfeit of $500 a day thereafter, less allowance for more than thirty days delay of City Council in approving contract.

In the general specifications repairs, replacements of defective apparatus, location and relocation of lines, conduits, replacement of pavements, etc., are placed under supervision of Board of Public Works, inspectors of such work at $75 a month to be paid by the company. Posts, guy stubs and the like once located by the board will be changed at the expense of the party requesting the change, as the board may determine. Lights may be changed, added to or discontinued above the minimum as the board may order. Fair provisions for requiring improvements with the advances in the art of electric lighting are made. The 5 per cent. of gross receipts paid by all holders of recent franchises to the city is required on this contract.

In specifications for work to be done, the lighting time is stated as from half-hour after sunset to half-hour before sunrise, and full schedule of times for every day is given. Lights in subways under railroads may be kept lighted during the day. Minimum current to be used per year by the city for all street lighting is 80,000 kw.

Company must patrol system for outages as required by the board, and broken globes or reflectors are counted as outages. Police are to make daily reports of outages. The deduction from contract price is $1 a day for each lamp.

City engineer will make tests of current and company must give room for recording meters furnished by the city, and opportunity for attaching and maintaining ammeters, volt meters or other measuring instruments on any or all circuits. If city engineer's tests show less current than contract requires, the price for the month the test is made will be reduced proportionately for all lights on the circuit so found deficient, representative of company to be given opportunity to observe tests. Engineer may remove lamps for test and make tests of them while in service, any lamp showing less than contract power to have proportionate deduction from price.

Arc lamps are to be connected not more than 100 in series in a circuit, of specified appearance and quality; of the differentially wound flame type with superimposed electrodes and focusing arc; double globes not requiring external reflector. Details of general construction, globe and electrode holder mechanism and globes are specified in full, also details of operation results. The mean lower hemispherical candle power must be at least 1,400, using clean inner and outer globes.

Incandescent lamps are to be latest improved series tungsten 100-watt and 60-watt, and over or under bridges when necessary carbon filament multiple lamps of light equal to 100-watt series tungstens may be ordered. Lamps are to be removed when candle power reduces below 90 per cent. of rated.

Outside the underground district arc lamps are to be supported on wooden poles with iron brackets of design shown in drawings unless ordered by the board to be other forms of brackets or suspension mounting. Incandescent lamps on Meridian street almost its whole length are to be three-lamp clusters, two at each street intersection, one at intersecting street and at least one single lamp intermediate between streets, to be supported on specified ornamental street lamp posts with underground connections, except one

mile in the center now partly supplied, which is not definitely specified. Incandescent lamps outside the underground district are to have radial wave reflectors of design specified and cluster lamp reflectors are specified.

The underground district is defined in which nothing is above ground but the posts holding the lamps. Conduits and their construction are specified in detail.

Arc lamps are to be 14 to 25 feet above street surface and incandescent lamps 12 to 14 feet high, except as specially ordered.

Lamp supports in underground district are to be iron posts set in concrete, with lamps on poles or brackets as ordered, from designs furnished in the bids, posts to be located as ordered by the board and subject to their change of location.

Pole lines in overhead circuits are fully specified in detail. Maps of circuits must be approved before construction. Joint use of poles by other wires is provided for. Electrolysis must be provided against reasonably.

One interesting provision is that street signs must be placed and maintained on each lamp, post or pole at a street intersection, which shall be satisfactory to the board or selected by it. Signs must be placed or painted on globes of incandescent cluster lights. Red glass rims one to two inches wide are to be put near top of globes at or near railroad crossings and at such street railroad crossings as the board may designate.

Meters on city building lines must be placed beyond the transformers or converters, so as to measure the rectified current.

Replacing of pavements, furnishing of plans and specifications for work to be done, quality of material and workmanship and of buildings are all covered.

Bids were received from (1) The Indianapolis Light and Heat Company, who hold the present contract, and from (2) The Merchants Heat and Light Company, with the following figures under the specifications, the latter being the low bidders and receiving the contract:

	(1)	(2)
Each 10-amp. A. C. enclosed flame carbon arc per year.	$60.90	$41.98
Each 100-watt series tungsten incandescent, except as specified for certain lights in underground district	31.50	17.83
Each 100-watt series tungsten incandescent lamp to be used as top lamp of 3 or 5-lamp cluster with underground service	32.60	8.92
Each 100-watt series tungsten lamp for lighting Meridian street and other underground service	32.60	27.71
Cluster of 3 100-watt tungstens	51.95	40.35
Cluster of 1 100-watt and 4 60-watt tungstens	60.95	45.18
Current for light and power in public buildings and places except those under Park Department	*	†

*Published schedule.

†1.95c per kw. hr.

The Indianapolis Light and Heat Company bid also on 460-watt 115-volt D. C. magnetite multiple arc lamps at $60.90. The company also proposed some modifications of specifications which would permit them to use some of their present installation to better advantage and bid thereunder $52.64 for 9.6-amp. D. C. flame arc lamps. But the bids of the Merchants Heat and Light Company were lower in every respect.

It was considered that the bid of the latter company was within the power of the company to make under the law establishing the State Public Service Commission, and that the rates thus established would be validated by filing them in regular form with the commission and the contract with that company has been approved by the Mayor and Board of Public Works and is now to be presented to the City Council for its action.

Gas for Light and Heat at the San Francisco Exposition

Gas is to be an important and versatile factor in the success of the Panama-Pacific International Exposition. To gas falls the duty of driving the chill from the great buildings at night and cooking the food required by hungry visitors. Added to these will be spectacular light effects in various courts.

The system by which the 635 acres of ground are piped for the demands that are to be made in 1915 is a testimonial to the great advance that has been made in gas distribution science.

St. Louis gas engineers engaged in solving the problem of gas supply in 1904 found it removed from the center of gas distribution with no large gas feeders. They depended on low pressure from the St. Louis mains. Since 1904 there have been rapid strides in the development of high pressure gas distribution, both for direct service and for boosting or reinforcing low pressure systems.

The Panama-Pacific International Exposition grounds are fortunately situated as far as gas delivery is concerned by being located directly on a high power loop extending from the gas works at the south end of the city almost around San Francisco to the north beach holder

station. This loop is a 16-inch steel main and its approach to the north beach is thru Webster street, which is almost the spine of the exhibition grounds.

From this 16-inch main is taken an 8-inch steel loop extending completely around the grounds. Another loop of 4-inch steel pipe circles the state and pavilion sites. The portion of the exposition grounds east of Webster street, including the amusement concessions, will be supplied from an 8-inch steel loop.

A high pressure system is installed at the 1915 exposition grounds. The gas is delivered into steel mains of smaller size under pressure measured by pounds to the square inch and the pressure is reduced by a regulator at each consumer's meter to a pressure in inches of water necessary to give the best results for the particular purpose for which the gas is to be used. For instance, for ordinary incandescent gas light a pressure of from four to six inches is most satisfactory, while for industrial uses pressure to as high as one pound may be employed with greater satisfaction and economy; and for the latest installations of high power lamps for street lighting, such as are now used in London, Paris and Berlin only, and which will be used for lighting the amusement streets at the exposition, a pressure of two pounds applied directly to the mantle gives the greatest lighting efficiency.

Another advantage of high pressure over low pressure is the ability to increase the supply of gas by increasing the initial pressure.

The Pacific Gas and Electric Company has installed for the exposition a loop system of more than nine miles of pipe within the fence which is without joints. All the steel tubes are welded together by the oxy-acetylene torch, using rods of Norway iron for the welding material. These welds are actually stronger than any other section of the great steel pipe, and the mains when finished consist of an endless welded tube without leaks. They are tested for leaks under a pressure of 100 pounds to the square inch, and will be absolutely tight under the maximum working pressure of 40 pounds to the square inch. The average pressure will be nearer 30 pounds. On Geary street, San Francisco, the first strip of welded steel pipe ever laid for high pressure was installed only a few months ago and the exposition test will be of great value in demonstrating the advantages of the new plan.

In the matter of measuring the gas supply for the exposition two of the latest meters will be used and scientific men will be able to watch this invention in an unusual test. Two Thomas electric gas meters will be used to record the flow of high-pressure gas. The gas that passes thru the meter is heated by means of an electric current and careful measurements of the quantity of electricity employed and the rise in temperature of the gas, taken with the known specific gravity of oil-gas, supply the factors for determining the exact quantity of gas used.

The gas that will be used is made from the California crude petroleum by a process which is itself Californian. It is produced from the oil with practically no by-products, such as result from coal gas manufacture. The gas is remarkably free from sulphur and other impurities. Its illuminating power is about 19 candle power and it has a heat capacity always in excess of 600 British thermal units per cubic foot. It is expected to provide an ideal fuel for heating, cooking, illuminating and all other purposes within the fair grounds, coupled with convenience and safety which are not enjoyed when solid or liquid fuels are used.

A part of the exposition lighting system will be an exhibition of high-pressure gas lamps, which will be used in this country for the first time. They will be placed in the section of the grounds occupied by the state and foreign pavilions and on the concession streets. They will stand on bronze uprights and will be attractive even when not lighted.

In the Court of Abundance gas will have its greatest part in the spectacular features of the exposition. The theme is the creation and development of the earth, and the history of man in symbol will be presented. Here the high-pressure gas will be used in great flaring flambeaux surrounding the lagoon in the center and outlined against the fireproof walls of the court. By the use of minerals distributed in the gas varied colors will be produced.

But important to the exposition and to the scientific world as these uses of gas are to be, its use in heating promises to excel all others. "Surface combustion" is something new in the scientific world, and this development of the use of gas will be given a complete test. This is the use of heat from gas without flame. The essential feature of this process is a homogeneous explosive mixture of gas and air, in the proper proportions for complete combustion, caused to burn without flame in contact with a granular incandescent solid, whereby a large proportion of the potential energy of the gas is immediately converted into the form of radiant heat. The combustion is greatly accelerated by the incandescent surface, and may be concentrated where the heat is desired. High temperatures are possible without the aid of elaborate regenerative devices; and there is a claim of twice the heat at half the cost.

Instead of requiring expensive heating

apparatus for the various concessionaries these radiant heaters will be sold or rented to them. They will also be installed in the Palace of Fine Arts and Festival Hall.

Gas will be used for patrol purposes and the grounds will be so well equipped with gas lighting that a complete suspension of electric power would leave the grounds well lighted. After the closing hours each night for the ten months gas will be used until daybreak.

Boston Street Lighting

Total lamps, January 10, 1914, 18,493; i. e., 4,718 arc, 3,507 tungsten incandescent, 10,268 gas. Increase over 1913, 380 arc lamps, 1,364 tungsten incandescent, and a decrease of 1,506 gas lamps. Cost of electric lighting for year 1913, $513,165, or $41,983 more than in 1912; of gas lighting, $264,682, or $15,748 less than in 1912.

Methods of Obtaining Salary Increases

As a result of an investigation of the employment of counsel by city employes and of possibly illegal payment of sums of money by clubs of employes for the purpose of influencing the City Council and the departments and Mayor to increase their salaries, the Finance Commission of the city of Boston, Mass., has made the following recommendations:

1. That increases of salary should be considered at the beginning of the fiscal year, and should be provided for in the budget, and not be made a matter of maneuvering at the close of one administration or near the end of a fiscal year, so as to embarrass the succeeding administration.

2. That the effect of using outside influence, as shown by the furtive and apparently unlawful means of effecting changes in the attempted appropriation of $400 by the Russell Fire Club of the Fire Department for the purpose of changing the meal hours, should be referred to the Fire and Police Commissioners for further inquiry and for action on their part.

3. That the Mayor take such action as is necessary to prevent the employment of counsel in the future on matters that are within the province of the Mayor and the heads of departments on one side and the men on the other to settle, except in the case of hearings on charges, etc.

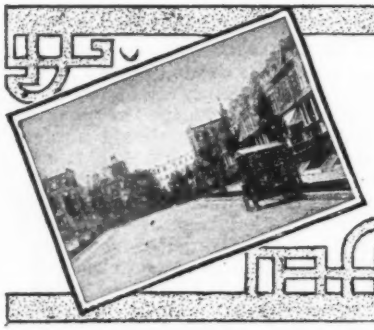
4. That rule 5, paragraph 3, of the Police Department Regulations, which states that "members of the force desiring promotion, transfers or assignments to particular duties are free to make their desires known thru the proper channels; and at suitable times members in person will be received by the commissioner at his office. But should a member cause a person not his superior in the force to intervene or to make representation in his behalf to the commissioner or to any superior officer, personally, or by letter, or by petition, he shall be deemed guilty of conduct unbecoming an officer," be so amended as to prevent the employment of counsel in departmental matters, between the Mayor, the Police Commissioner and the members of the force.

5. That in all departments a rule, whether existing now or not, permitting the men to interview the head of the department on any question of grievance, should be made a reality. Grievance committees of the men and the men individually should be welcome at all times to lay their requests and grievances before the heads of the several departments and the Mayor.

Motor Truck Service and the Public Roads

Ten years ago the motor truck gave little promise of becoming a great factor in the movement of commerce. The comparatively few in use at that time, which were at all reliable and could really be depended on to deliver the goods, were the electric-driven. It did not seem probable that the gasoline-driven motor truck on the public road would ever come into such general use as ever having to be reckoned with in all matters pertaining to road construction. But the year 1913 saw over 36,000 motor trucks built in this country and the public highways under construction today must be constructed to stand up under this ever-growing number of commerce-bearing vehicles. Road foundations and road surfacings, heavier bridges and permanent culvert construction are all now very carefully looked after by the engineer to meet these new conditions.

Even the country roads leading off from main thorofares are affected by these changes, for they, too, must have culverts of unquestioned strength to replace the dangerous small bridges. There has been much thoughtless talk of the increased cost of road building, but what was once done in a most haphazard way is now done with a view to permanence. This in the long run makes for fewer bond issues and lower taxes.



MISCELLANEOUS

Paul E. Kressly

The first city manager of Inglewood, Cal., under the ordinance creating that office, which was published in the April number of MUNICIPAL ENGINEERING, is given the duties of that office, in addition to those of city engineer, which he has been performing for two years.

Mr. Kressly has been in the active practice of civil engineering for twelve years, tho only 32 years old. For about nine years of that time he was located at South Bethlehem, Pa., acting also as boro engineer of Nazareth, Fountain Hill and Freemansburg, Pa. Three years ago he went to Inglewood and was in due time appointed city engineer, where there has been full exercise of his activity, as the city is spending more money for improvements than any other city of the same class in the State. In 1912 there was expended for street improvements alone $178,996.98, and in 1913 $202,304.20. That these expenditures have been made to the satisfaction of the Council, under Mr. Kressly's supervision, is shown by his advancement to the new position with materially greater responsibilities.

Personal Notes

Isham Randolph, consulting engineer, has moved his office to 1827 Continental and Commercial National Bank Bldg., Chicago, Ill.

J. E. Greiner, Consulting Engineer, has associated Ezra B. Whitman with him and they have offices at 1308 Fidelity Bldg., Baltimore, Md.

Philip H. Dater has been appointed city engineer of Portland, Ore.

H. R. Carter is the new State Highway Engineer of Arkansas.

E. A. Kingsley, former State Highway Engineer of Aakansas, has been appointed engineer of road construction about Temple, Tex., the present work in sight amounting to about $600,000. Mr. Kingsley retains his office in Little Rock, Ark., and will also have an office in Temple, Tex.

Julian Kendrick has been appointed city engineer of Birmingham, Ala.

Electrolysis of Water Pipe in Appleton, Wis.

The Editor of MUNICIPAL ENGINEERING:

Sir—In your recent issue of April, I notice a letter from C. H. Vinal, City Engineer of Appleton, Wisconsin, asking "Is this a case of Electrolysis?"

From the location of the pipe and the condition which unquestionably existed, it is electrolysis. The fact that there was no indication on the voltmeter, shows but little, unless the voltmeter was one having a scale reading of not over 5 volts. I have personally found many locations where serious damage has occurred where the voltage was not over half as a maximum, and frequently ran at lower than one-half a volt. All that is required is a favorable condition for the passage of the electric current, for decomposition of iron by the electric current can take place at a very low voltage, and frequently does.

Mr. Vinal does not state where the car was at the time the test was made for

voltage. Much would depend on this, for as it is an interurban line with probably cars at infrequent intervals, if the car was not at a point beyond the break from the powerhouse, there would be very small voltage and probably a comparatively small flow of current. The spark might readily come from the slight induction that exists in the discharge from an iron pipe.

Another factor of importance, too, would be the condition of the ground, which might make it possible to have a very heavy flow of current at a very low voltage.

I would recommend Mr. Vinal inserting a low reading voltmeter between the pipe and the rail, taking a reading and then short circuiting the voltmeter by means of a heavy wire, and see if there is any material drop in voltage under these conditions. This would give a very strong indication as to what was going on, for, if the insertion of the heavy wire did not make a marked change in the voltage, it would indicate that the ground itself was a very good conductor.

HENRY D. JACKSON,
Consulting Engineer, Boston, Mass.

Civil Service Examinations

The United States Civil Service Commission will hold examinations at the usual places as follows:

May 11: Associate physicist qualified in engineering, especially in fire-proof materials, in Bureau of Standards, Pittsburg, Pa., at $2,200 to $2,700, and at Washington, D. C., at $2,200 to $3,500 a year.

May 20: Junior railway signal engineer, punior mechanical engineer, junior electrical engineer, junior structural engineer, under the Interstate Commerce Commission at $1,080 to $1,500 a year.

Technical Associations

The forty-sixth convention of the American Society of Civil Engineers will be held in Baltimore, Md., June 2-5. The program includes a reception on the evening of June 1; social and business features on the 2d, including consideration of a proposed code of ethics; an excursion to graduation week at Annapolis on the 3d; brief addresses on features of Baltimore by city officials and others under the headings "City Planning and Paving," "Drainage and Sewerage," "Harbor Work," "Water Supply and Filtration" on the 4th with excursions to see the improvements described and a reception and ball in the evening; and excursions to Sparrows Point and Fort Howard on the 5th, with a smoker in the evening.

The National Old Trails Road Association holds its convention at the Claypool Hotel, Indianapolis, Ind., on May 7-9, the last day being Indiana Day with a business meeting of the Indiana Good Roads Association.

The Sixth National Conference on City Planning will be held at Toronto, Ont., May 25-27. Aside from the general discussions of city planning and its relations to other functions of city government, the subjects discussed include rapid transit, including the auto bus, garden cities and suburbs, water fronts, recreation facilities, etc.

A snow removal conference was held in Philadelphia April 16 and 17 in which the directors of public works, street cleaning commissioners, etc., of New York, Boston, Philadelphia, Scranton, Pa., Portland, Ore., Newark, N. J., and Washington, D. C., took part.

The Record of the National Fire Prevention Convention has been printed, 600 pp., and can be obtained of Merchant & Evans Co., Philadelphia, at 85 cents in paper and $1 in cloth.

The fourth American Road Congress to be held under the auspices of the American Highway Association will be held at Atlanta, Ga., Nov. 9-14, 1914. Charles P. Light, business manager, Colorado, Bldg., Washington, D. C. The 1914 Good Roads Year Book of this Association has just been issued bound in cloth, and is worth may times the dollar charged for it to any one interested in good roads and their construction.

The fourth annual convention of the Tri-State Water and Light Association of the Carolinas and Georgia was held in Atlanta, Ga., April 16 and 17. M. A. Stubbs, secretary.

The American Water Works Association holds its 34th annual convention at the Bellevue-Stratford hotel, Philadelphia, Pa., May 11-15. John M. Diven, secretary, Troy, N. Y.

Technical Schools

The Iowa State College at Ames has published Bulletin 33 of the Engineering Experiment station on "House Heating and Fuel Tests," which compares the efficiency and economy of various Iowa and Illinois coals, Tennessee smokeless, gas house and process coke, anthracite and peat at the prices prevalent in Iowa. It should be of great value to all interested in the subject, because the results can be applied anywhere, tho prices are those of Iowa.

"The Mortar-Making Qualities of Illinois Sands," by C. C. Wiley of the Department of Civil Engineering of the University of Illinois, has just been issued as Bulletin No. 70 by the Engineering Experiment Station of that university. This

bulletin discusses the effect of the characteristics of the sand upon the quality of mortar. The results of a series of tests on thirty-two representative Illinois sands are given in tabular form and discussed. A classification of different sands is then proposed and specifications for each class suggested. Copies of Bulletin No. 70 may be obtained upon application to C. R. Richards, Acting Director of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

Throop College of Technology, Pasadena, Cal., publishes a program of a competition with cash prizes of $200, $100 and $50 and honorable mentions, for a scheme of development of four corners each 200 feet square at the intersection of two 70-foot streets. Drawings are to be filed with Geo. A. Damon, Dean of Engineering, Sept. 1, 1914, who will give further information on the subject.

Publications Received

Report of the Chief of Engineers, U. S. Army, for 1912. Paper, 1,349 pp. W. H. Bixby, Chief of Engineers, Washington, D. C.

The Ohio Valley Flood of March-April, 1913, including comparisons with some earlier floods. By A. H. Horton and H. J. Jackson. Paper, 96 pp. Water Supply Paper No. 334 of the U. S. Geological Survey, Department of the Interior. George Otis Smith, director, Washington, D. C.

Engineering and Architectural Jurisprudence: A presentation of the law of construction for engineers, architects, contractors, builders, public officers and attorneys at law. By John Cassan Wait, M. C. E., LL. B., attorney and counselor at law and consulting engineer. Cloth, 905 pp., $6. John Wiley & Sons, New York City.

Report of the Board of Water Commissioners of East Orange, N. J., for 1912. Paper, 36 pp. Arthur A. Reimer, engineer.

The Economic Cost of the Smoke Nuisance to Pittsburg. By John J. O'Connor, Jr., A. B. Paper, 46 pp., 25 cents. Smoke Investigation Bulletin No. 4 of the Mellon Institute of Industrial Research and School of Specific Industries, University of Pittsburg, Pa.

Pure Iron vs. Copper-Bearing Steel: A brief for the plaintiff, with historical data bearing upon the development of the rust-resistant metals in the United States. By Allerton S. Cushman, Ph. D., Director. Paper, 47 pp. Bulletin No. 5 of the Institute of Industrial Research, Washington, D. C.

South Philadelphia: The abolishment of grade crossings and the creation of opportunities for commercial and industrial development. Paper, 72 pp. Department of Public Works, Philadelphia, Pa.

The Strength of I-Beams in Flexure. By Herbert F. Moore. Paper, 40 pp., 20 cents. Bulletin No. 68 of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

Sixth Annual Report of Pasadena's Municipal Lighting Works Department, for year ending June 30, 1913. Paper, 32 pp. C. W. Koiner, electrical engineer and general manager, Pasadena, Cal.

General Statistics of Cities, 1909: Including statistics of sewers and sewage disposal, refuse collection and disposal, street cleaning, dust prevention, highways, and the general highway service of cities having a population of over 30,000. Cloth, 197 pp. Prepared under the supervision of LeGrand Powers, chief statistician for finance and municipal statistics, Bureau of the Census, U. S. Department of Commerce, Washington, D. C.

Annual Report of Department of Street Cleaning of New York City for 1912. Paper, 23 pp. William H. Edwards, commissioner of street cleaning.

Road Laws of West Virginia, 1913. Compiled by State Road Bureau, A. Dennis Williams, chief road engineer, Morgantown. Paper, 122 pp. Issued by department of agriculture, Howard E. Williams, commissioner, Charleston, W. Va.

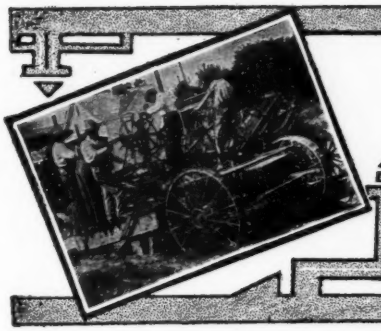
Report of Public Service Commission for the first district of New York. Vol. III. Statistics of Gas and Electric Companies in New York City. Cloth, 527 pp. O. F. Weber, chief statistician.

Sanitation at Mining Villages in the Birmingham District, Alabama. By Dwight E. Woodbridge. Paper, 27 pp. Technical Paper No. 33 of the Bureau of Mines, Department of the Interior, Washington, D. C.

Trade Waste Waters: Their Nature and Disposal. By H. Maclean Wilson, M. D., B. Sc., chief inspector, West Riding of Yorkshire Rivers Board, and H. T. Calvert, M. Sc., Ph. D., F. I. C., chief chemical assistant. Cloth, 340 pp. J. B. Lippincott & Co., Philadelphia, Pa.

The Elements of Specification Writing: A text-book for students in civil engineering. By Richard Shelton Kirby, C. E., professor of civil engineering, Pennsylvania College. Cloth, 125 pp., $1.25 net. John Wiley & Sons, New York City.

Annual Report of the City Engineer of Cambridge, Mass., for year ending March 31, 1913. Paper, 18 pp. L. M. Hastings, city engineer.



MACHINERY AND SUPPLIES

Trinidad Asphalt For Maple Road, Indianapolis

The Board of Park Commissioners of Indianapolis, Ind., has awarded to the Marion County Construction Co., the contract for the improvement of the boulevard on Thirty-eighth street, hereafter to be known as Maple Road, and they will use Trinidad asphalt in the work.

The width of the entire improvement is 100 feet and there are the usual specifications for grading, preparing sub-grade of roadway, lawns, and house connections to sewer, sewer extensions, inlets, catch-basins, manholes, concrete combined curb and gutter, cement sidewalks, etc.

The roadway is to be paved with an asphaltic concrete wearing surface laid on a concrete foundation, using Trinidad asphalt in the top.

The mineral aggregate of the wearing surface is to be a mixture with sand and in some cases a small quantity of stone dust or portland cement, and any sound durable stone, either trap rock, limestone, or granite, usually considered suitable for macadam, broken as nearly cubical as practicable, not showing distinct planes of cleavage or crystalline faces and not readily crushing or splitting under the roller. The size is crusher run passing a ¾-inch screen and held on a 10-mesh screen, dust or fine screenings being removed. The sand is to pass a ¼-inch screen and not over 5 per cent. pass a 200-mesh screen, and not over 30 per cent. held on a 10-mesh screen. Not over 4 per cent. by weight of portland cement or ground limestone is to be added to the mixture, the resulting aggregate mixture not to contain over 10 per cent. of materials passing 200-mesh.

The specifications for the bituminous material conform with those of the American Society of Municipal Improvements with two or three minor exceptions.

The proportions of materials are 3 parts of stone, 2 parts of sand and 7 to 10 per cent. by weight of bitumen, the stone dust, if any, not exceeding the above 10 per cent. by weight passing a 200-mesh screen.

After mixing hot according to standard specifications a thin coat of the asphaltic cement is spread uniformly over the concrete at a temperature of 300 to 325 deg. F. on which, while still hot the paving mixture is spread thick enough to roll down to 2 inches.

A seal coat of asphaltic cement, of consistency to be flexible when cold, is spread over the surface at proper temperature between 200 and 300 degrees and evenly spread with rubber squeegees without excess over amount necessary to fill voids, on which immediately is spread a top dressing of ¼ to ⅛-inch Wisconsin red granite chips, with a small surplus to be worn in by the traffic.

The pavement is about 1½ miles long, with 41,956 square yards of asphaltic concrete and 1,140 square yards of concrete pavement. The estimated total cost is $119,898.45.

The Squeegee Cleaning Indianapolis Streets

The Street and Sewer Committee, of the Indianapolis Chamber of Commerce, recently reported its observation of the operation of new street cleaning machines on the streets of the city and commends the present city government for this effort to improve the cleanliness of the streets, a matter which has been sadly neglected for several months. The machines work on the same principle as the rubber squeegee for cleaning windows and other smooth surfaces. The strips of rubber are arranged in parallel spiral lines around a cylinder which is revolved in opposite direction to the motion of the wagon by proper conection with the axles of the wagon wheels, and as the wagon moves along they scrape the pavement clean. The cylinder is set at a slight angle so that the dirt is swept towards the gutter. On the wagon is a water tank which supplies the small amount of water necessary for the cleaning operation, thru a horizontal perforated pipe immediately in front of the revolving cylinder.

The test of the efficiency of such apparatus is the removal of horse droppings which have been flattened onto the pavement by wheels running over them. Judged by this criterion the machine is much more efficient than the ordinary broom street sweeper, and it raises no dust.

The city had a couple of these machines several years ago, but on some change of administration they were set aside by some street superintendent who had other interests, but the present administration seems to have recognized their merits and starts in with two new machines.

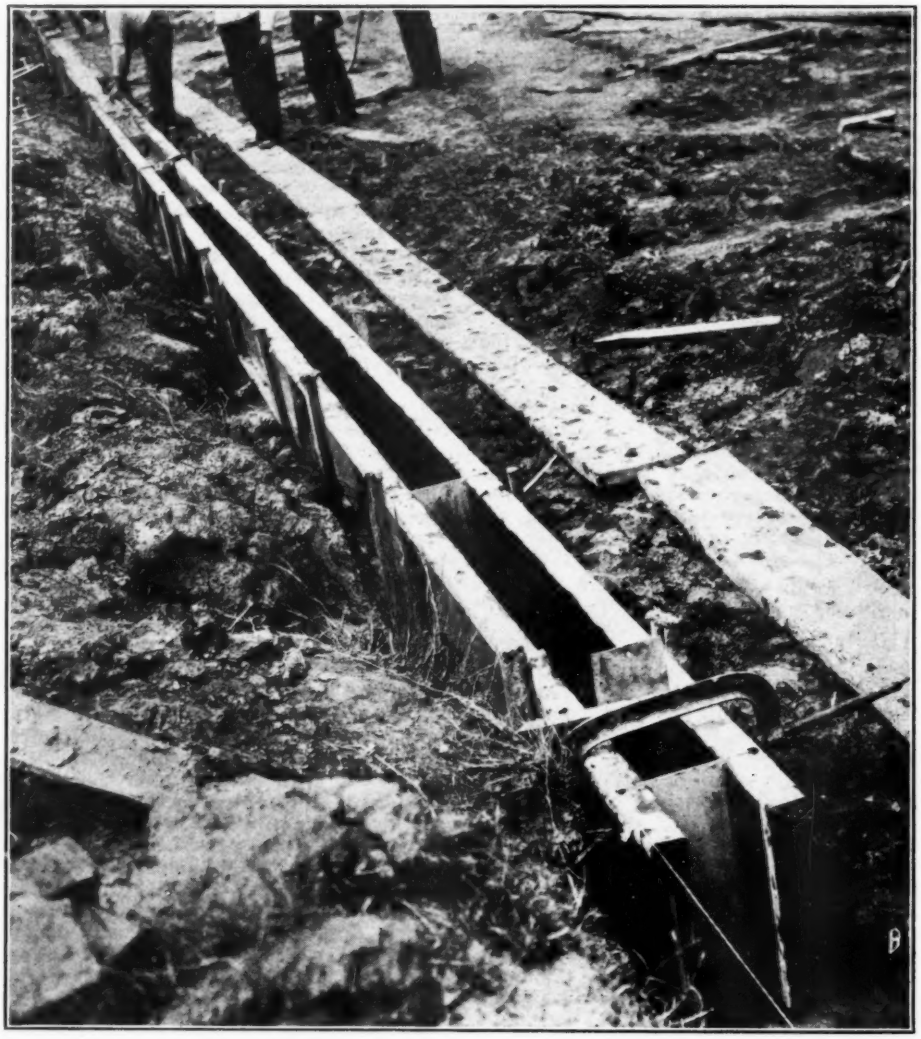
The machine referred to is made by the Kindling Mfg. Co., of Milwaukee, Wis., who issue a catalog fully descriptive of its operation.

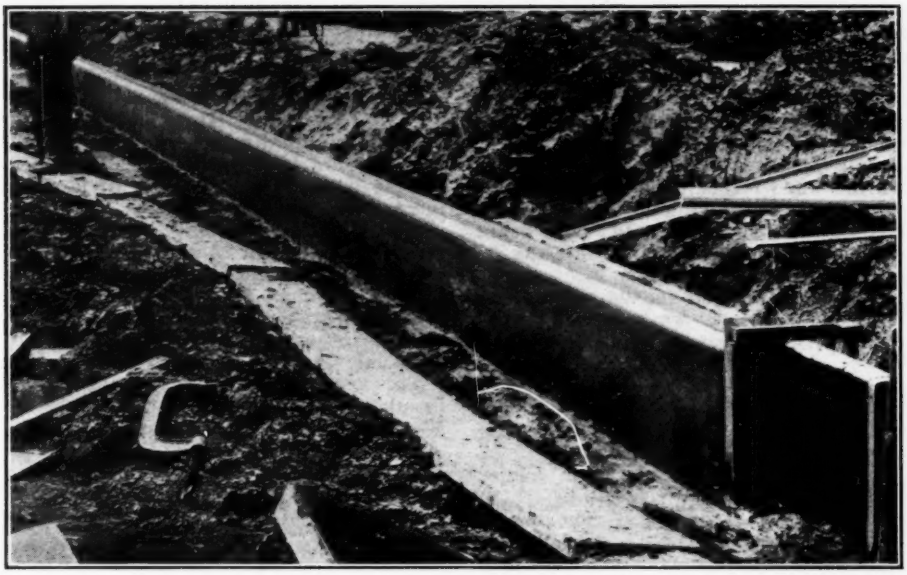
Reinforced Concrete Curb in Detroit

A method of protecting the corner of concrete curb with a steel bar has been developed by the Trussed Concrete Steel Co., of Detroit, Mich., which is shown in the accompanying photographs.

The first photograph shows the entire operation of laying the curb, on Crane avenue, Detroit, Mich. In the immediate foreground is the line for locating the curb exactly for grade and alinement,

LAYING REINFORCED CONCRETE CURB *in Detroit. Steel forms in foreground, filled with concrete farther back. Putting corner bar in place and finishing top in background.*





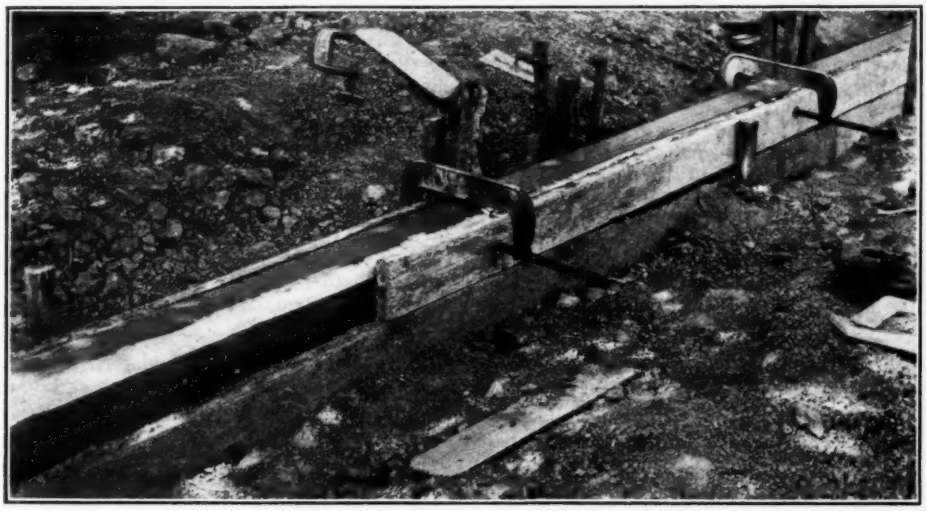
REINFORCED CONCRETE CURB *made in wooden forms, which are partly removed to finish surface, and show steel corner curb bar.*

and steel forms are shown in place with the stakes for holding them rigid, the joint plates and the clamp for keeping the forms in exact position with respect to each other. Farther in the rear the concrete has been filled into the form and the first workman seen removes the joint plates and is seen placing the curb bar, which he does by forcing it into the wet concrete so that its anchoring parts are thoroly surrounded by the concrete and it is held completely and immovably by the concrete when it has set. The workman in the background is finishing the top surface of the curb.

REINFORCED CONCRETE CURB *with steel forms removed. Note rounded steel protected corner.*

The second photograph shows the curb with the forms removed.

The third photograph shows the curb



laid on Bewick Ave., St. Clair Heights, Mich., using wooden forms. Part of the form has been removed, showing part of the face as well as the top of the curb and the Trus-Con Curb Bar No. 1, which gives the rounded appearance to the curb corner.

In all the cases shown but particularly with the wood forms, the front surface of the curb is carefully smoothed and finished with a steel trowel, the forms being removed early enough so that this can be done.

The materials used in the curb are 1 part cement, 2 parts washed sand and 3 parts washed gravel.

Water Meters in Houston, Tex.

The city of Houston, Texas, is operating its water supply system on a meter basis, having made the change since 1907. In that year the average daily consumption per capita was 147 gallons. Today with an increase of 50 per cent. in population the average is 51 gallons. This is the summary of the showing that the unmetered consumer wastes much more water than the metered consumer.

The present stock of meters includes 7,801 Trident, 49 Trident-Crest, 196 Crown, 340 Empire, 1,666 Lambert, 19 Gem, and 27 miscellaneous. David Fitzgerald, water commissioner, is highly in favor of the meter system.

Aztec Asphalt

With the advent of the automobile a crying necessity was occasioned for something to apply to suburban and rural roadways, which would prevent dust and disintegration. The roadway development has caused an enormous increase in the production and use of asphalt. The consumption of asphalt has approximately trebled in the past five years.

Particularly for paving and road building purposes, the asphalt selected should be one that combines high cementing value, ductility and a low susceptibility to extremes of temperature. With these qualities combined in an asphalt it is ideal for paving and road making purposes.

Aztec asphalt possesses these vital elements and consequently is recognized by asphalt chemists, engineers and contractors as one of the best asphalts on the market. It is produced from a maltha (fluid bitumen or liquid asphalt). The maltha is found in the State of Vera Cruz, Mexico (the land of the Aztecs). The deposits are situated some little distance inland, approximately between the ports of Tampico and Tuxpam on the Gulf of Mexico. The maltha is conveyed by pipe lines to a seaport and thence shipped by tank steamers to the refinery of The United States Asphalt Refining Company at East Brooklyn, on Chesapeake Bay, ten miles from the City of Baltimore, Md.

The maltha is refined expressly for the asphaltic contents. It is distilled carefully and gradually at a temperature that will not crack or coke the bitumen, so that it will not be rendered lifeless and inert as a cementing agent.

Every device of science, together with a perfect system of control, have been installed at the refinery. The result is the production of an asphalt that is uniform in character, possessing all the vital essentials of a perfect bituminous paving material.

This material is placed on the market by the U. S. Asphalt Refining Co., 90 West St., New York City.

Creosoted Wood Block Paving in Jersey City

Jersey City, N. J., has 66,000 square yards of creosoted wood block paving, of which 9,500 square yards was laid in 1913. About 5,000 square yards will be laid in 1914. The average cost of the pavement is $2.77 a square yard. On medium traffic streets, where wood is mainly used, there is slight indication of wear and there has been some buckling which is attributed by the city's engineers to laying the blocks too close together.

The lack of dust is given as one of the advantages of wood block pavement, tho slipperiness is prevented by sprinkling sand on the surface of the street.

A 2 per cent. grade or less is preferred. The blocks used are 3½ inches in depth and they are laid on a bed of mortar 1 inch in depth. An expansion joint 1¾ inches thick at top edge and ½ inch at bottom is constructed along each curb. The joints between blocks are filled with portland cement grout, spread in scoop shovels.

Southern long-leaf yellow pine is the wood specified, not less than 90 per cent. heart-wood. A 20-pound treatment with creosote oil of 1.03 to 1.10 specific gravity at 38 deg. C. is prescribed, the oil to be a pure coal-tar product or in proportion of ½ coal-tar and ½ water gas tar, free from adulteration, petroleum oil or any of its products, and containing less than 5 per cent. of matter insoluble in benzol.

The Best Solution of the Smoke Problem

By W. C. Kirkpatrick, Chicago, Ill.

Quite often we are reminded of the fact that we have the cart before the hourse and the way in which the remark

is usually made is suggestive of the fact that we are not properly hooked up for good work, and it is under these conditions that I see the many organizations working that claim to be trying to solve the smoke nuisance question and work out methods that are practical for the abatement of same.

They are employing expert scientific men and consuming millions of dollars as well as unlimited energy in trying to gather data showing how many tons of soot, or gallons of sulphuric acid are produced and distributed over a square mile, or trying to estimate how many millions of dollars worth of property is destroyed each year by the great volumes of smoke produced from our wilful, wasteful method of consuming coal.

Yet there is not a school boy or girl ten years of age who cannot tell that the great volume of smoke polluted air they breathe is a detriment, that the soot damages their toys, books, cards, etc., and the expensive data gathered by scientific men, do not prove a single thing of material value that cannot be established by every man, woman and child in the large city.

Then again, we find the same condition existing with other organizations and individuals, but they are endeavoring to work out some scientific and practical plan of consuming smoke, or a method whereby our high volatile coals can be utilized and eliminate the result of the smoke.

Millions of dollars per year are spent in this pursuit and a great amount of valuable energy is constantly being consumed in trying to successfully destroy the effects of liberating the millions of tons of volatile constituents in the bituminous coals.

But the real loss, a loss amounting to over five billion dollars per year directly due to the almost universal method of permitting the valuable by-products contained in high volatile coal to be destroyed, is the loss that really affects the individual and national welfare.

The output of the high volatile coal mines of the whole world exceeds one billion tons per year, and if distillation plants were erected at the mines so that all coal for domestic purposes would be distilled, and if all raw coal transported from the mine would be run thru distillation plants located in connection with manufacturing plants, then the volatile constituents would be subjected to destructive distillation under simple scientific conditions that would obtain a maximum yield of all valuable by-products.

Should the method be universally employed, we would obtain approximately 12½ million tons of ammonia sulphate, having a commercial value of over seven hundred and fifty million dollars, and ten billion gallons of tar having a commercial value of over three hundred million dollars, or these two items alone which unfortunately in our wilful, wasteful methods we convert into smoke, have a commercial value of our one billion dollars. This shows the direct loss only, and does not show the great profits that could be made by the use of the ammonia sulphate in agriculture.

Distilled coal is smokeless, and not necessarily coked, but semi-coked, containing just enough of the hydrocarbons to make it hold a fire readily and burn without a heavy draft. When distilled it is free from volatile and moisture and runs high in carbon, hence you pay the freight on that part of the coal that produces the greatest number of heat units per pound, and consume it in the most efficient manner, entirely eliminating smoke.

I almost forgot one of the constituents or products produced in the distillation process, and a rather important one, the gas. In the distillation of our billion tons of high volatile coal we would produce approximately 20 trillion feet of 300 B. t. u. gas that would generate 400 billion kw. hrs, and at one cent per kw. would have a commercial value of four billion dollars, making a total commercial direct loss to the world of over five billion dollars per year under the present system.

I know this is correct, also that the cart is before the horse, and if all the great trained minds, the scientific men who are chasing undisputed well known facts, will concentrate their minds upon the distillation of coal, if the great organizations and foundations, etc., will spend their millions along efficient lines and concentrate their energy upon the subject of simple low temperature distillation together with simple inexpensive recoveries, we will soon subdue the great smoke nuisance of the world in a simple way, by distilling the coal, leaving the carbon free from volatile combustible matter or a smokeless coal.

Then when it is a well established fact that it can be done in a practical, simple, inexpensive way (and it can), enact laws, not to prosecute a manufacturer for creating smoke, but for wasting natural resources, and enact laws making it unlawful to use raw fuel. I heartily endorse Professor Armstrong and his letter read before the British Association for the Advancement of Science held in Birmingham, England, Sept. 10-13, 1913, upon that subject, and believe that before we can accomplish the desired result, laws will have to be made which render it illegal to use raw fuel.

Reverse the method of trying to produce the result, and instead of trying to

work against nature assist and co-operate with nature in order to produce the result in an economical, simple, natural way.

No chemical enginer who is honest with himself and actually having in mind the solving of an analytical problem will persistently try to work against nature. He will try to combine natural elements in a manner intended to aid and assist nature to produce certain other compounds or results.

Having this thought in mind I shall ask all who are interested in the smokeless city, the smokeless village and I may say the smokeless universe to consider the subject right end to, and concentrate their efforts to the production of a smokeless fuel and saving the tremendous values contained in the volatile combustible matter which at present escapes thru the chimney, pollutes the atmosphere, causing ill health, filth, damage to property, all deplorable conditions.

The M-C Paving Mixer

The M-C paving mixer justly attracts the careful attention of all who have to do with the building of country roads or city streets. The following brief description is presented to bring clearly to contractors and road builders reasons why this paver should be given consideration.

The mixer drum will hold 11 cubic feet of wet mixed concrete, or about 16 cubic feet of unmixed sand, stone and cement per batch. A 2-bag batch of 1-3-5 concrete can be mixed without slopping.

The machine may be operated by either steam or gasoline power. The gasoline engine furnished is a 12-h.p. double opposed cylinder New-Way engine, of the air cooled type. The steam power consists of 10-h.p. steam engine with 12-h.p. steam boiler. Power as great as 10-h.p. is not, of course, necessary to operate the mixer drum and loading hopper. As a matter of fact, a 6 or 7-h.p. engine is sufficient. The surplus power is provided to handle properly the traction feature while moving on bad or hilly roads.

Like the traction engine and the automobile, the M-C paver is equipped with both a high and a low running gear. The low speed (½ mile per hour) is more satisfactory while laying concrete. It is likewise desirable when the machine is operated on planks for the protection of the grade, as it is desirable, when moving only a few feet at a time, to move slowly. Further, when traveling to or from a job, if the road is rough, the paver should be run at low speed to prevent excessive vibration of the mechanism. Or, if the roads are muddy or there is an up grade, the low gear is desirable, as it enables the operator to pull out of situations that would be impossible at a higher speed.

The high speed (1¾ miles per hour), enables the operator, when the condition of the road permits, to travel quickly from place to place.

It is never necessary to load this paver on a wagon. It can get there under its own power.

A band brake, gripping a rim on each traction wheel, and patterned after the brakes on an automobile, insures safety while the machine is going down hill.

Further to facilitate traveling on bad roads, and to enable the machine to round corners without straining, a differential gear is furnished in the traction drive. This is a very important detail that has been adopted by manufacturers of all high grade traction equipment and should never be omitted from a paving mixer.

The steering is controlled by a hand wheel at the operator's platform. The operator has a clear view both ahead and to the rear. There is no difficulty in guiding the machine when traveling on either the high or low gear. Steering chains are provided with heavy springs for the important purpose of relieving the mechanism of all shock.

The wheels are extra large and heavy. The driving wheels are 36-inch diameter by 10-inch face, fitted, if desired, with cleats. The steering wheels are 30 inches in diameter by 8-inch face. The traveling qualities of the outfit are entirely satisfactory because of the size of these wheels.

For spreading concrete on wide streets the M-C delivery boom is unique. It consists of an open trough in which a mixing conveyor constantly revolves. In effect this is a continuous mixer, giving the concrete an extra "turn-over" after it leaves the main mixer drum.

The trough is fitted with three gates, dividing its length into four sections, each approximately 4 feet long. The concrete can be spread therefore, at a radius of 4, 8, 12 or 16 feet from the mixer.

The type of delivery boom has the following advantages, and there is no other boom that has so many:

1. It gives the concrete an extra mixing.

2. It is open for its entire length and, therefore, readily cleaned and kept in repair.

3. It delivers the concrete at four different distances from the mixer, making it necessary to move the machine only every 16 or 18 feet as the work progresses.

4. The machinery required to operate is reduced to a minimum. No engineer must handle it, as one of the labor gang can open or shut the gates when necessary.

Tarvia

Preserves Roads
Prevents Dust

East Front Street, Newbern, N. C

The circle shows the street during the flood. The larger photograph shows the same **after** *the flood — the Tarvia pavement uninjured.*

Even Floods do not affect a Tarvia Roadway—

Here is a road that was built in 1911 with a five-inch concrete base and a two-inch macadam surface bonded with Tarvia.

In September, 1913, it was flooded by river and tide in a great storm, as shown in the small picture. When the waters subsided, the tarviated road was unharmed and no repairs were required! The larger photograph was taken *after* the flood.

The City Engineer, Raymond R. Eagle, writes:

"While this was a very severe test on the pavement it stood up perfectly under it and the pavement remained in as good condition as before the storm." He also says: "The Tarvia has given entire satisfaction."

Tarvia is a coal tar product of great bonding power.

It encloses the stone in a tough matrix from which neither water nor traffic can tear it loose.

It vastly increases the durability of the road and usually cuts down the repair bill enough to offset the entire cost of the treatment.

Booklet regarding the Tarvia treatment free on request.

BARRETT MANUFACTURING COMPANY

New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland
Cincinnati Minneapolis Pittsburgh Seattle Birmingham
THE PATERSON MFG. CO., Limited:—Montreal Toronto Winnipeg Vancouver
St. John, N. B. Halifax, N. S. Sydney, N. S.

TRADE B MARK

5. The trough is always ready to receive a batch from the mixer, and there is no waiting for a bucket or car to come into position before a batch may be discharged.

6. This type of boom has less tendency to overturn the mixer than any other, because it is hung so low that its leverage is reduced to a minimum. And because, too, the weight of the apparatus is never concentrated at the end of the boom, as is the case when a dump bucket carries an extra batch of concrete to the end of the track on which it runs.

On roads up to 18 or 20 feet wide the M-C chute for spreading the concrete is recommended. This chute swings in a semi-circle, delivering the concrete either at the end, or by folding it back at a 4-foot radius.

The loading hopper is of the pivoted type, opened on the back and rounded on the edge so barrels may be wheeled into it from an angle and easily dumped.

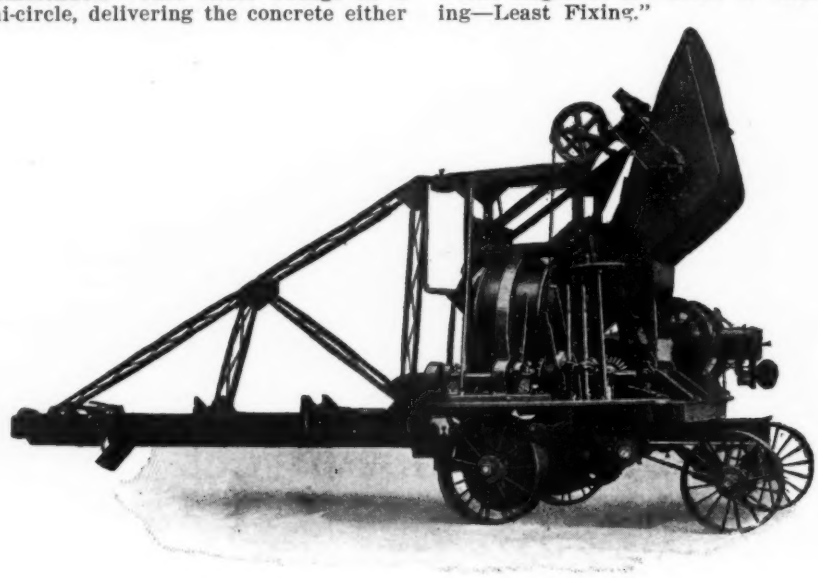
The hopper bottom and sides are so steep when discharging into the mixer, and the throat of the hopper is so large, there is no choking of the material. The hopper always clears itself, and not even a grain of sand is spilled.

All levers are banked on one side of the machine, so one man can conveniently control every operation of the mixer and of the traction from the one position. The platform is of checkered floor plate, providing the best kind of a footing for the operator.

The gasoline driven machine, without delivery boom, weighs approximately 10,000 pounds, and the steam driven outfit about 10,500 pounds. The extra weight of delivery boom is about 1,000 pounds or of the delivery chute about 300 pounds, including all attachments.

Clutches are provided so no shafts nor gearing for one operation are running idle while another operation is being performed. The drum does not turn while the traction gearing is moving the machine, and vice versa. Power, therefore, is concentrated where it is required.

The slogan of the mixer is "Most Mixing—Least Fixing."



THE MARSH-CAPRON CONCRETE PAVING MIXER. *Note loading device and mixing delivery chute, which can discharge concrete at four points four feet apart.*

Cement-Finished Floors

The Trus-Con Laboratories, Detroit, Mich., have issued a valuable booklet giving full and concise specifications for producing cement-finished floors that will not continually dust under light traffic and rapidly wear away under heavy service by the use of Trus-Con floor hardener, a very simple method that any experienced workman can apply without the attention of any special superintendent.

Rules of the Road

In line with their policy of supplying motorists service, the B. F. Goodrich Company have recently issued a booklet, "Rules of the Road." The purpose is to help further the safety-first movement by putting valuable hints in such concrete shape that they can be quickly mastered by the man behind the wheel.

INVESTMENT versus SPECULATION

Bitulithic

IS AN ASSET. IT IS AN INVESTMENT—*NOT* A SPECULATION.

Investigate **Bitulithic** before determining to use inferior street paving. It is cheaper to have good pavements in the beginning than to contract for cheap constructions which have to be repaired every year.

There is no guess-work in the construction of **Bitulithic** pavement. It is made of varying sizes of the best stone obtainable, combined with bituminous cement and laid under close laboratory supervision. You must realize that quality is remembered long after the price is forgotten. The character of a city is indicated by the condition of its streets.

Bitulithic. Jasper Avenue, Edmonton, Alta.

Bitulithic is - Unequalled in reputation.
Bitulithic is - Unquestioned in quality.
Bitulithic is - Unrivalled in popularity.
Pavement of prestige - **Bitulithic.**

DO NOT HESITATE—investigate at once—specify **Bitulithic** and have a pavement which is "built up to a high standard and not down to a low cost"—the pavement of quality.

Write today for explanatory booklets and learn more about this modern pavement for modern cities.

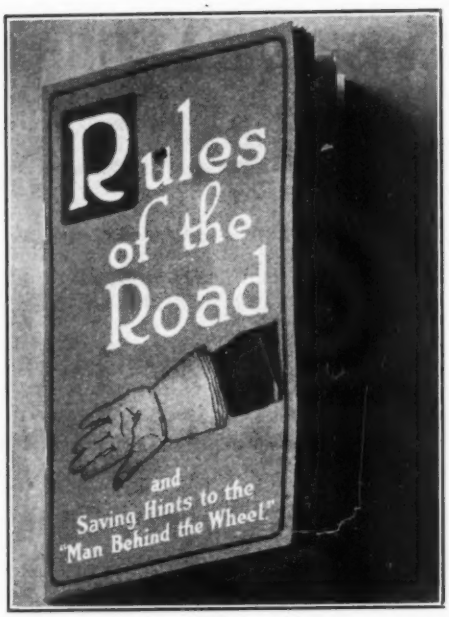
Warren Brothers Company

EXECUTIVE OFFICES:
59 Temple Place, BOSTON, MASS.

DISTRICT OFFICES:

NEW YORK, N. Y.	CHICAGO, ILL.	ROCHESTER, N. Y.	LOS ANGELES, CAL.	PORTLAND, ORE.	PHOENIX, ARIZ.
50 Church St.	10 S. LaSalle St.	303 Main St., West.	926 Calif Bldg.	Journal Bldg.	204 Noll Bldg.

NASHVILLE, TENN.	RICHMOND, VA.	ST. LOUIS, MO.
606 First National Bank Bldg.	Virginia Railway & Power Bldg.	Railway Exchange Bldg.



Both new and experienced drivers will appreciate the information contained in "Rules of the Road." It tells in clear, concise manner many regulations which new drivers must usually acquire from costly and embarrassing experience. It gives rules governing street traffic, such as passing, turning, stopping and starting. Also data on precedence on right of way, speed laws, respective rights and duties of drivers and pedestrians, lights, etc.

Then follow chapters on care of tires, how to make repairs, how to secure the Goodrich touring service, road marking service, good roads, and how to secure the benefits from Goodrich service stations.

Co-operation of Towns in Fire Fighting with Auto Apparatus

At the spectacular Wellesley College fire a few weeks ago there occurred an interesting occurrence not generally known but of great significance as illustrating the modern method of co-operation between fire departments which have motor-driven apparatus.

As the local Wellesley department was poorly equipped for fighting a large fire of this character aid was called for from the nearby towns and cities. The City of Newton responded promptly by sending its Knox pumping engine and Knox-Martin tractor with hook and ladder truck, two pieces which it has put in service within the last few months.

On account of the confusion attendant at the fire the Newton department did not get the call until some time after the fire had started, but made a splendid run over the intervening six miles in a very few minutes, although the road was foggy and very slippery in spots.

The building was practically doomed when the Newton apparatus arrived, but the pump immediately coupled up to a hydrant and pumped steadily for over three hours and a half, with two lines out, saving the right wing of the building. The pump was handicapped on account of water, but, in spite of this, gave a splendid performance, making the first real hard test which it has had since it was installed a few months ago.

Had the motor apparatus been called a little more promptly and had the other neighboring towns been able to send any similar motor equipment, the Wellesley fire disaster would have been a very different story, for the effective work performed by the Knox pump under its severe handicap shows what would have been possible with a little more of the same effective kind of co-operation.

As the various cities and towns, particularly in a locality where they are so close together as in Eastern New England, become better equipped with motor apparatus, the outlook is very promising for some splendid work along these lines, and it would even appear as tho the time would eventually arrive when a serious conflagration would be almost an impossibility, on account of the prompt and powerful co-operation thus made possible by modern motor equipment.

Cushion Tires for Trucks and Fire Department Service

Motor truck operators are becoming more far-sighted every day according to C. W. Martin, Jr., manager of the Motor Truck Tire Department of the Goodyear Tire & Rubber Co.

Martin says in part: "The great majority of truck owners are thru with the penny wise and pound foolish idea. They realize that a slightly increased expenditure in the beginning generally means a big saving in the end and especially is thus true in buying tires.

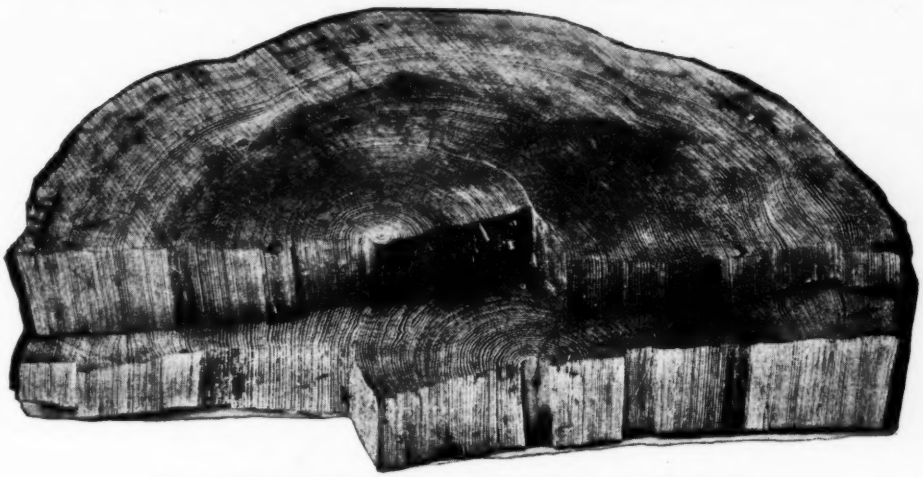
"Take for instance the Goodyear Cushion Demountable tire. After it had proven itself so thoroly in fire department service we put it on the market for commercial use with the result that the tire was immediately and widely demanded in spite of the fact that the initial cost was slightly higher than that of the ordinary solid tire.

"The reason truck owners were willing to do this is very apparent. A little study showed at once that the saving in upkeep especially in the renewal of engine and

SOUTHERN YELLOW PINE

THE BEST WOOD FOR CREOSOTED PAVING BLOCKS

Because Its STRENGTH And SERVICE is NOT Affected BY CREOSOTING



Close Annular Rings, Dense, Hard, Strong and Durable.

Mr. A. B. McFarland, Engineer of Tests, Atchison, Topeka & Santa Fe Railroad System, at Topeka, after making extensive and thorough tests with Southern Yellow Pine Timbers (Bulletin No. 149, A. R. E. A., 1912) states:

"The data shows conclusively that Long Leaf Pine timber which has been subjected to the full cell process of creosoting and allowed to weather for a year, ***is in no way inferior to untreated timber.*** When tested immediately after treatment, results show that treated timber to be slightly inferior to the untreated timber."

No such statements concerning "other structural woods now commercially available" are to be found, notwithstanding standard tests have been made by qualified investigators.

"Best timber for engineering structures where great strength, long span and durability are required."

The facts are, *Southern Yellow Pine* has made "Creosoted Blocks" a popular paving material, owing to its *great strength under end compression, dense, hard texture and uniform straight grain.* The resin this wood contains is a preservation in itself, so that Yellow Pine blocks, when properly creosoted, will insure absolute paving satisfaction for *years* in the most trying, congested traffic districts of our largest cities, namely, New York, Boston, Chicago, St. Louis, Atlanta, Cincinnati, Detroit, Louisville, Memphis, etc.

MR. ENGINEER: Hereafter be explicit. ***Specify "Southern Yellow Pine"*** for your next creosoted paving block contract. It makes an ***economical*** and ***desirable street pavement from every standpoint*** and gives ***longer*** and ***more efficient service*** for the money expended than any other pavement known to engineers.

No royalties paid for its use, and no large repair appropriations necessary.

WRITE FOR LITERATURE AND INFORMATION.

Yellow Pine Manufacturers' Association, 711 Wright Building, ST. LOUIS, MO.

chassis parts in a year's time amounted to quite an item.

"The jolts and shocks a truck receives under ordinary operating conditions will react without appreciably lessened force on the mechanical parts to an extent that is bound to result in a certain amount of injury or wear. This means just so much tacked on to the yearly repair and overhauling bill that a Cushion tire could reduce to a minimum.

"Truck owners who have adopted Goodyear Cushion Demountable tires for equipment have without exception reordered for the saving in this particular item of expense alone."

Tandem Motor Roller

The Austin-Western Road Machinery Co., Karpen Bldg., Chicago, Illl., have issued the "first fully descriptive catalog of the first successful tandem roller built in the United States" and will send it on request to any one interested in road and pavement construction and machinery.

Trade Notes

The Curtis-Ward Co., general contractors, 28 E. Jackson St., Chicago, Ill., have been awarded contract for equipping Park Ridge, Ill., with 200 street signs and standards similar to those erected by them in Chicago. The signs which are being used in Park Ridge are comparatively inexpensive and cost much less than those used in Chicago. They are, however, handsome in design and attractive in appearance.

The city of Chicago has ordered 500 additional street signs from the Curtis-Ward Co., 28 E. Jackson St., Chicago, Ill., to be installed on the boulevard systems, they already having with the city the largest contract for street signs ever awarded.

Owing to increased business the Raymond W. Dull Co., Chicago, Ill., have found new quarters at 1910 Conway Bldg., 111 W. Washington St.

The Chicago mixer which was formerly sold by The Chicago Concrete Machinery Co., has been taken over entirely by the T. L. Smith Company, 3122 Hadley St., Milwaukee, Wis., and will form a part of their regular line. It has been entirely re-designed and will be known as the Smith-Chicago mixer.

The MacArthur Concrete Pile & Foundation Co., New York City, has been awarded the contract for the concrete pile foundations of the three-story reinforced concrete factory building and power house for the Willys-Overland Co., automobile manufacturers, Toledo, Ohio; of a retaining wall to be constructed between 138th and 141st Streets, the Bronx, New York City, by the New York Connecting Railway; and of two large storehouses to be erected by the United States Government at Ft. Mason, San Francisco, Cal.

Dunn's wire-cut-lug blocks are in use as paving material for yards, factories and warehouses by many industrial concerns such as the Yale and Towne Co., Eastman Kodak Co., Niagara Falls Power Co., etc.

Trade Publications

One of the handsomest catalogs received lately is catalog No. 19 of the Koehring Machine Company, Milwaukee, Wis., devoted to their line of concrete machinery. It is not only handsome but useful, as it is difficult to find a question about any of their machinery which is not answered in full in the book.

The Conley Incinerator System, patented by Joe Conley, of Oklahoma City, is described in a pamphlet issued from the San Francisco office, Monadnock building. One form is a combination latrine and incinerator for camp and army use, which is modified for school and institution use.

The Turner combination drag line ditcher and shovel is described in a booklet of the United Iron Works Company, Springfield, Mo.

A booklet of the Northwestern Expanded Metal Company, Chicago, on concrete culverts shows a number of photographs of culverts reinforced with their Econo expanded metal.

A booklet describing the Stickney siphon spillway and automatic crest for dams is issued by the Hydraulic Specialties Co., Albany, N. Y.

"Culverts" is the title of a booklet issued by the Pennsylvania Metal Culvert Co., Warren, Pa.

The Trus-Con Laboratories, Detroit, Mich., issue a circular descriptive of Trus-Con waterproofing paste, under the title, "What It Has Done and Where It Has Been Used."

The "National Bulletin" is devoted to the characteristics of "National Pipe" of the National Tube Co., Pittsburg, Pa.

America's Telephones Lead the World
Service Best—Cost Lowest

from London "Daily Mail"

Why is it that Government ownership and management of the telephones is practically always a failure?

Why is it that throughout the length and breadth of Great Britain and the Continent hardly a single efficient long-distance service is to be found? Wh... is it that in ... York one ...

from "Electrical Industries" (London)

THERE is a certain amount of satisfaction in the fact that Mr. Winston Churchill got so angry over the freaks of the telephone the other day that he flung his receiver on the floor. As a member of the Government which purchased the telephone system, he deserves all the torture that Post Office working can inflict. But his rage, ... delicat... ... doubtless ...

From "Le Petit Phare de Nantes," Paris

"But today I found I had to talk with Saint-Malo, and, wishing to be put through quickly, I had my name inscribed on the waiting list first thing in the morning; the operator told me—though very amiably, I must confess—that I would have to wait thirteen hours and ten minutes (you are reading it right) in order to be put through."

Herr Wendel, in The German Diet.

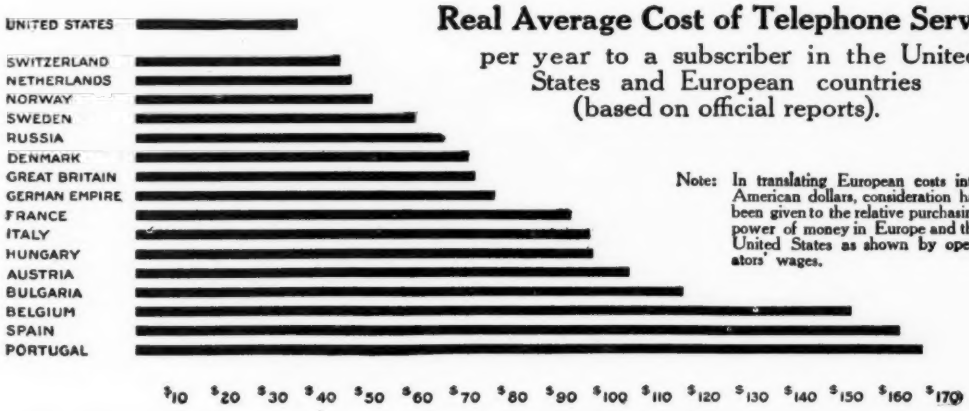
"I refer here to Freiberg. There the entire telephone service is interrupted at 9 o'clock p. m. Five minutes after 9 o'clock it is impossible to obtain a telephone connection."

Herr Haberland, Deputy, in the Reichstag

"The average time required to get a connection with Berlin is now 1½ hours. Our business life and trade suffer considerably on account of this lack of telephone facilities, which exists not only between Dusseldorf and Berlin and between Berlin and the West, but also between other towns, such as Strassburg, Antwerp, etc."

Dr. R. Luther, in the Dresdner Anzeiger

"In the year 1913, 36 years after the discovery of the electro-magnetic telephone, in the age of the beginning of wireless telegraphy, one of the largest cities of Germany, Dresden, with half a million inhabitants, is without adequate telephone facilities."



Real Average Cost of Telephone Service

per year to a subscriber in the United States and European countries (based on official reports).

Note: In translating European costs into American dollars, consideration has been given to the relative purchasing power of money in Europe and the United States as shown by operators' wages.

These are the reasons why there are twelve times as many telephones for each hundred persons in the United States as in Europe.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy ***One System*** ***Universal Service***

CONTRACTING NEWS

AUTOMOBILES—FIRE APPARATUS.

BIDS REQUESTED.

Clinton, Iowa—May 12, until 8 p. m., for one motor tractor for hook and ladder truck; truck weighs about 7,000 lbs. Certified check 10 per cent. of bid. Frank W. Leedham, city clerk.

Yankton, S. D.—May 11, until 8 p. m., for one combination hose, ladder and chemical motor-driven fire truck. Photographs and complete specifications of the complete equipment and truck must accompany all bids. Dr. E. M. Doyle, chairman of joint committee of city commissioners.

CONTEMPLATED WORK.

Madison, Wis.—An auto truck for No. 3 fire station and a runabout for fire chief. O. S. Norsman, city clerk.

Moline, Ill.—Motorization of fire department. Bond issue, $34,500. John Q. Hawk, fire chief.

Nashua, N. H.—Combination motor truck, supply wagon for fire department, and an ambulance, all motor driven. Appropriation, $10,000.

Omaha, Neb.—Bids to be asked for an automobile for health commissioner. Thos. J. Flynn, city clerk.

BRIDGES.

BIDS REQUESTED.

Independence, Mo.—May 14, until 11 a. m. for constructing following drains on Marty road: Six-foot masonry arch culvert, head walls and wings to be raised; 6-foot masonry arch culvert to be lengthened and masonry head walls built; 3-foot by 3-foot concrete box culvert to be lengthened; 4-foot by 4-foot concrete box culvert; 30-inch concrete box culvert; 2-foot by 2-foot concrete box culvert. Certified check, $100.00. Roland T. Proctor, county surveyor.

Marion, Ohio—May 26, until noon, for substructure for bridge across Scioto River at Green Camp. Certified check, $200.00. V. Perle Garfield, clerk, board of Marion County commissioners.

Piqua, Ohio—May 26, until 10 a. m., for reinforced concrete bridge on Union street in Piqua. Certified check, 5 per cent. of bid, made payable to county auditor. L. P. Knopp, county surveyor.

Salisbury, Md.—May 19, until noon, for two lift bridges, including substructure and superstructure, of 40-foot clear span, roadway 18 feet with two sidewalks each 5 feet, over South Prong of Wicomico River at Camden avenue and South Division street crossings. Certified check, $200.00. H. M. Clark, roads engineer, Wicomico County.

Tiffin, Ohio—Until May 23, for three concrete arch bridges over Sandusky River in this city. Robert H. Lee, engineer, Williamson Building, Cleveland, Ohio.

Troy, Ohio—May 15, until 10 a. m., for reinforced concrete bridge in Union street, Piqua, Ohio; for substructure of Landman bridge two miles north of Piqua; for steel superstructure for Landman bridge; for substructure and steel superstructure of Buck Neck bridge, two miles south of Bradford, Ohio. Certified check, 5 per cent. of bid, made payable to M. T. Staley, auditor, Miami County.

Vernon, Ind.—Until May 21, for concrete brdige across Big Creek. G. J. Bernhart, auditor, Jennings County.

Westmoreland, Kans.—May 22, until noon, for bridge over Blue River between Riley and Pottawatomie Counties. Geo. Hungerford, county clerk, Manhattan, Kans.

Winchester, Ill.—May 16, until noon, for reinforced concrete bridge known as Knapp bridge in North Winchester Township, Scott County. Estimated cost, $2,200. Geo. H. Vannier, county superintendent of highways, Bluffs, Ill.

Kokomo, Ind.—May 23, until 10 a. m., for following bridges: Ohio street in Kokomo over Wildcat Creek, and an additional span to McCann street bridge over Wildcat Creek; the O'Dowd Ford bridge over Wildcat Creek on Center and Harrison Township line; the Barber road bridge in Ervin Township. E. B. Swift, auditor, Howard County.

CONTRACTS AWARDED.

Big Timber, Mont.—To Security Bridge Co., Billings, Mont., bridge across Yellow Stone River at $14,995.

Davenport, Iowa—To March Engineering Co., Des Moines, contract for six bridges and steel concrete substructures of two steel bridges at $8,050; to Clinton Bridge Co., contract for superstructure of three steel bridges and concrete substructure of 40-foot steel truss bridge at $8,080.

Hamilton, Ohio—To A. J. Yawger & Co., Indianapolis, for 475-foot concrete bridge over Miami River, High street, Hamilton, at $142,440.90; to Hackedorn Contracting Co., Indianapolis, Ind., three-section concrete bridge and two-section viaduct at Middletown, Ohio, over Miami River, at $252,718.30.

Havre, Mont.—To O. C. Peppard Bridge Co., Missoula, Mont., three bridges in Hill County at $30,000.

Massillon, Ohio—To Riverside Bridge Co., Martins Ferry, viaduct in Massillon over Tuscarawas River, Ohio Canal and several railroad tracks, length 705 feet, contract price $28,100.

Ogdensburg, N. Y.—To Kirk, Raleigh & Co., Syracuse, N. Y., reinforced concrete bridge across Oswegatchie River at $68,500.

Oskaloosa, Iowa—To Koss Construction Co., Des Moines, for 34 bridges and culverts in Mahaska County at $13,588.

Thermopolis, Wyo.—To Monarch Engineering Co, Falls City, Neb, for bridge across Big Horn River at $8,012.

Wentworth, N. C.—To Vincennes Bridge Co., Vincennes, Ind., bridge across Dam River near Draper, N. C., at $14,890.

CONTEMPLATED WORK.

Beaufort, N. C.—Bond issue of $80,000 voted for construction of concrete bridge across Beaufort river from Beaufort to St. Helena Island, length 1,600 feet. J. B. Walker, chairman bridge commission.

Butte, Mont.—Plans submitted for bridge over Big Hole River by County Surveyor W. T. George. Bids will be asked for shortly. Estimated cost, $15,000.

BUILDINGS.

BIDS REQUESTED.

Tampa, Fla.—May 12, until 2 p. m., for City Hall and police headquarters. Certified check, 2 per cent. of bid, made payable to Board of Public Works. D. B. McKay, chairman of board.

Waterbury, Conn.—Until May 29, bids will be received for municipal building at Grand and Field streets; four stories, 144x200 feet,

Cleaning Railway Cars by Vacuum

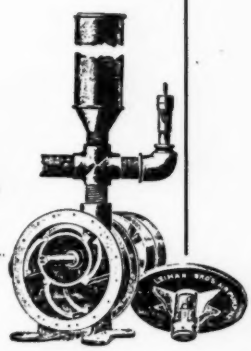
is being done in **many cities** with our **Vacuum Pumps.** A **powerful** suction can **draw out** the **dust** from **all** crevices and keep the cars **clean** and **sanitary,** and they look **like new** always. **Trolley cars** and **automobiles** are also **cleaned** in **this** way. We can supply a **big** machine with power enough to operate **two tools** at once for **far less** than you could buy one of the many **little portable** outfits.

This machine is made for **hard, strenuous** work, and will **last** a **lifetime.** It can be placed on a **hand truck** or **automobile** and **100** or **200** feet of **hose** used so that an entire **school** building, **theatre,** or in fact **any** structure may be **quickly** and **easily** cleaned. It can **also** be used as a **blower** for **many** other purposes, such as **burning out** stumps, **renewing** school **blackboards, brazing,** etc.

Catalog No. B4AL

LEIMAN BROS.

B4AL 62 John St. NEW YORK.



brick and limestone. Estimated cost, $600,000. Cass Gilbert, architect, 11 West Twenty-fourth street, New York City. Wm. H. Sandland, 111 West Main street, Waterbury, clerk of committee.

CONTRACTS AWARDED.

Dillon, Mont.—To Wm. G. Rreed, city, two-story and basement and reinforced concrete City Hall at $27,930.

Negaunee, Mich.—To Ford E. King, Hancock, Mich., City Hall, at $49,192; to Swanson Bros., city, plumbing and heating at $9,986.

CONTEMPLATED WORK.

Dothan, Ala.—Plans to be prepared by Morris & Morris of Atlanta, Ga., City Hall, cost $40,000.

Indianapolis, Ind.—Public Library Building, plans being prepared by Paul P. Cret, Borie, Zantzinger & Medary, Philadelphia. Estimated cost, $427,500.

Sandusky, Ohio—City Hall at cost, of $50,000 or $60,000; and police station on East Market Square, at cost of $40,000 to $50,000. Jacob Dietz, mayor.

GARBAGE DISPOSAL.

BIDS REQUESTED.

South Orange, N. J.—May 15, until 8 p. m., for collection, removal and disposal of ashes, rubbish, paper and garbage. Certified check, $500.00. M. A. Fitzsimmons, village clerk.

LIGHTING.

Brockton, Mass.—Removal of 80 arc lamps in street lighting system and substitution of about 300 incandescent lamps is planned. Jas. Hayes, Jr., city engineer.

Butler, N. J.—$35,000 bond issue will be voted shortly for installation of municipal electric light plant.

Conway, Ark.—White Way lighting system will be installed shortly. Estimated cost, $3,000. E. V. Leverett, superintendent of city lighting.

Earlville, Iowa—Erection of municipal electric light plant is being considered. Bond issue, $10,000. Mr. Vanfleet, mayor.

Franklin, Texas—$17,500 bonds voted for municipal electric light plant and water works.

Indianapolis Ind.—Contract awarded Merchants Heat and Light Co., city, at $41.98 per year for street electric arc lights—10-year contract. B. J. T. Jeup, city engineer.

Oak Harbor, Ohio—Contract awarded Gangle-Harbaugh Co., Akron, Ohio, for general construction of municipal electric light system at $7,169.75; to W. G. Nagel, of Toledo, Ohio, switchboard, at $1,302; to Joseph Skeldon Engineering Co., Toledo, pumps, at $1,340.

Pompton Lakes, N. J.—$20,000 bonds voted April 11 for municipal electric light plant. J. Frank Cornelius, boro clerk.

Pasadena, Cal.—Contract awarded Woodill & Hulse Co., Third and Main streets, Los Angeles, for installation of ornamental lighting system on Colorado street at $18,500.

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Albany, N. Y.—May 11, until 1 p. m., for LeRoy-Caledonia road, length 3.24 miles. Certified check, 5 per cent. of bid. John N. Carlisle, state highway commissioner.

Cincinnati, Ohio—May 15, until noon, for improving Ohio pike, repair of Springfield pike and Cheviot road. Certified checks, $500.00, $500.00, $1,000.00 respectively. Fred E. Wessellmann, president, county commissioners.

Elgin, Ill.—About June 15, for 30,033 square yards asphaltic concrete pavement on Center street, Hill avenue and Addison street. Morgan H. Brightman, engineer.

Elgin, Ill.—Until May 12, for 10,696 square yards brick pavement on South State street; 15,953 square yards asphaltic concrete on Park street; 2,450 square yards asphaltic concrete curb and gutter in certain streets. yards asphaltic concrete on Commonwealth avenue. Morgan H. Brightman, engineer.

Evansville, Ind.—May 18, until 10 a. m., for grading, draining and paving with brick Henderson road, in Pigeon Township, Vanderburgh County. C. P. Beard, auditor.

Fort Dodge, Iowa—May 11, until 9 a. m., for paving and constructing Portland cement concrete curb and gutter ,in certain streets. Certified check, 10 per cent. W. L. Tang, city clerk.

London, Ohio—May 12, until noon, for grading and paving North Main street with vitrified paving brick or asphalt block, or creosoted or kreodone wood blocks. Certified check, $1,000. J. W. Byers, village clerk.

Murray City, Ohio—May 12, until noon, for grading, curbing and paving with brick, Locust street. Certified check, $800.00. Oscar Albaugh, village clerk.

New Lexington, Ohio—May 25, until noon, for excavating, grading and paving with brick, constructing concrete curbs on both sides of Brown street from High street to Toledo & Ohio Central Railway tracks. Certified check, $500.00. Thad B. Skinner, village clerk.

Philadelphia, Pa.—May 15, until noon, for 601 cubic yards grading, 6,290 cubic yards pavement on concrete base, 45,300 square yards bituminous pavement, 35,800 square yards waterbound macadam, 8,800 square yards vitrified and stone block gutters, 3,040 lineal feet concrete curbing, five concrete arch bridges, 14,000 lineal feet piling, and 50,000 cubic yards grading for islands in League Island Park. M. L. Cook, director, public service, Room 225, City Hall.

Rawson, Ohio—May 25, until noon, for pavement on South Main street. Certified check, $200.00. Chas. H. Fetzer, village clerk.

San Antonio, Texas—Until May 16, for 78 miles gravel road and 2,700 cubic yards concrete culvert work. V. H. Howard, uditor, Bexar County.

St. Clairsville, Ohio—Until May 15, for paving Old National pike; work will be let in three sections; estimated cost $100,000. Address Belmont County commisioners.

Sullivan, Ind.—May 16th, until noon, for 23,330 feet stone road in Jefferson Township, 5,307 feet in Cass Township, and 19,123 feet gravel road in Gill Township. Wm. S. Bicknell, auditor, Sullivan County.

York, Pa.—May 15, until noon, for paving portions of various streets; work includes grading, laying of concrete base and about 70,000 square yards vitrified brick, sheet asphalt, bitulithic or wood block. Certified check, 5 per cent. Calvin A. Boyer, superintendent of streets and public improvements. Geo. A. Warner, city engineer.

CONTRACTS AWARDED.

Aurora, Ill.—To J. E. Salfisberg & Co., city, contract (sub-leased by McCarthy Improvement Co) for paving portion of Garfield and Calumet avenues and Le Grande boulevard.

Baltimore, Md.—To D. M. Andrews Co., city, resurfacing 4.5 miles of Emmitsburg road at $24,068.70; to Bamberger-Chapman Co., resurfacing 4.4 miles of National pike from Middletown to Washington County at $26,237.35.

Boards of Health! —Investigate—

the hygienic advantages of dry, clean, odorless, sanitary, antiseptic

SOLVAY
Granulated Calcium Chloride

as a road binder and preventive of one of the most dangerous factors in the spread of disease—dust.

Citizens will unanimously welcome its use, and road commissioners will appreciate the big saving in labor and apparatus and the simplicity of repair work. It will save a big proportion of road maintenance expense.

Belair Place, Milwaukee, Wis.

It is sown dry with a lime spreader. Upon exposure to the air it immediately absorbs and holds the moisture, works into the road and keeps the surface in perfect condition. Solvay Granulated Calcium Chloride is not only the least expensive binder, but best combines

Binding Efficiency and Healthfulness

Send for Illustrated Road Book

SEMET-SOLVAY CO. **Syracuse, N. Y.**

Many Municipal Buildings Now Heated with Exhaust (Waste) Steam

Scores of municipal buildings are now heated practically *without cost*—simply by utilizing exhaust steam (ordinarily a sheer waste) carried through J-M Sectional Conduit from the power room.

In other cases, where the heating is the sole consideration, or too big a thing to depend on exhaust steam, detached buildings are heated, at a *tremendous saving*, by conveying steam from a central heating plant through

J-M SECTIONAL CONDUIT

Through pipes protected with J-M Sectional Conduit, steam can be carried at least 600 feet without the loss of a single pound pressure, and can be carried much longer distances without any appreciable loss of heat, and with no condensation—something impossible with other conduits.

Thus, by the use of J-M Sectional Conduit, one large heating plant does the work of many small ones—does it better—does it at far less cost, for fewer men are required, less coal is needed, and a cheap coal serves just as well as the higher-priced grades.

In many cases where the J-M Sectional Conduit plan of heating is in use, the saving in coal and labor runs $1,000.00 a year and over.

J-M Sectional Conduit usually pays for itself in about five years, and is just as efficient at the end of ten or fifteen years as at first, while there is no maintenance cost whatever.

Comes in sections and can be easily opened up to locate leaks in the pipe. And it can be taken up and relaid.

It is the only water-tight conduit. There are many other advantages, all told in our Catalog No. 112, which you can get merely by writing our nearest branch.

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Boston	Cleveland	Kansas City	Minneapolis	Philadelphia	St. Louis
Buffalo	Dallas	Los Angeles	New Orleans	Pittsburgh	Syracuse

JOHNS-MANVILLE SERVICE COVERS THE CONTINENT

THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED, Toronto, Montreal, Winnipeg, Vancouver. 1327

Carrolton, Wash.—To Jeffery & Bufton, Portland, Ore., 3 miles highway north of Carrolton at $22,732.

Chariton, Iowa—To H. J. Cathroe, Omaha, Neb., Division "B," alley paving, cement concrete, at $11,855.30; to J. W. Turner Improvement Co., Des Moines, Ia., Division "A," street paving, brick, at $77,171.

Clarinda, Iowa—To J. S. McLaughlin & Son, Red Oak, 31,063 square yards concrete pavement at $54,161.

Conway, Ark.—To McCullough & Halter, Conway, concrete paving in business district at $20,000.

Delevan, Ill.—To H. K. Rhoades, of Lincoln, Ill., for 22 blocks of pavement at bid of $47,626.60.

Desplaines, Ill.—To Standard Paving Co., Grand boulevard paving at $16,502.45.

Hamilton, Ala.—To Jordan & Phillips, Aberdeen, Miss., 18 miles of pike road at $42,000.

Harlan, Ind.—To John H. Zimmerman, Harlan, stone road in Springfield Township, Allen County, at $22,745.

Hoopeston, Ill.—To H. C. Finley, city, West Main street paving at $12,980.34.

Huntington Beach, Cal.—To Frank Oswald, Los Angeles, concrete pavement with oiled macadam wearing surface on Seventeenth street at $24,570.

Indianapolis, Ind.—To Marion County Struction Co., city, asphaltic concrete paving Thirty-eighth street from Capitol avenue to Fall Creek at $11,925.

Kingston, Pa.—To B. G. Coon, Union street, Dorranceton, Pa., for 5,500 square yards brick paving and 2,100 lineal feet curbing at $17,200.

Kokomo, Ind.—To William & Edw. Mahoney, Lafayette, stone roads and brick pavements in city at $50,000.

Lake Charles, La.—To Southland Company of Lake Charles, Southland Company of Meridian, and Healy Construction Co. of Jackson, Miss., contracts for 45 miles of new highway amounting to $150,000.

Lake Geneva, Wis.—To D. A. Thatcher, River Forest, Ill., for 21,288 square yards creosoted wood block pavement at $2.14 per square yard; 5,875 lineal feet cement curbing, 36 cents; 682 lineal feet gutters at 65 cents and 390 lineal feet protection curbing at 10 cents. Total cost, $48,154.

Los Angeles, Cal.—To B. F. Ford and F. H. Stout, city improvement of Avenue 20 at $28,623; to F. W. Whittier, 1146 Title Insurance Building, improvement of Childs avenue between Fountain and Effie streets at $7,219.

Painesville, Ohio—To Lesher & Roess, Oil City, Pa., for South Ridge road, brick or concrete at $68,309.

Racine, Wis.—To Delta Constructing Co., Escanaba, Mich., for concrete road in town of Caledonia at $20,836.64; to Birdsall-Griffith Construction Co., Racine, for concrete road work in town of Mount Pleasant at $10,525.11.

Raleigh, N. C.—To R. G. Lassiter, Oxford, for street paving to be done during 1915.

Sacramento, Cal.—To John W. McDonald, San Jose, asphalt surface on State Highway between San Jose and Mulia at $15,869; to Berry Mackie & Co., San Francisco, 4.5 miles cement concrete highway in Humboldt County at $45,097; to Lynn S. Atkinson, Los Angeles, for 12.4 miles cement concrete work from Dearborn to North Line of Kern County at $48,110; to Tieslau Bros., San Francisco, highway from Hayward to Valla Vista school house at $19,538; to W. A. Perry, Los Angeles, for 11.5 miles Portland cement concrete in San Diego County, at $69,395; to C. L. Hyde Construction Co., San Diego, 2 miles Portland cement concrete, San Diego County, at $11,741.90; to Ransome-Crummey Co., Oakland, 5.1 miles asphaltic concrete work in in Alameda County, at $53,263; to Hard Bros., Sacramento, 5 miles of grading in Mendocino County at $51,381.

Salem, Ohio—To J. D. Paxon, Salem, at $20,799, Kane & Smith, Youngstown, at $11,849 and $6,036 improvement of roads with slag macadam.

Salt Lake City, Utah—To J. W. Mellen, city, 20,000 square yards asphaltic pavement at $132,260.

Sandy Lake, Pa.—To Vetter Construction Co., Meadville, Pa., West Main street paving at $16,488.30.

Seattle, Wash.—To Washington Paving Co., Savage-Schofield Building, Tacoma, Wash., grading and graveling H. H. Howard road at about $38,000.

Sharpsville, Pa.—To Turner & Olson, Youngstown, Ohio, 12,000 square yards brick pavement on Seventh street and Ridge avenue at $1.77 per square yard.

Shelbyville, Ill.—To File & Alexander, of Decatur, Ill., for paving various streets at $56,421.77.

South Bend, Ind.—To Rankert & Eggleston, city, asphaltic concrete paving on Cedar street at $18,741.94.

Tacoma, Wash.—To Joseph Water, Sr., city, South Ninth street, paving, asphalt, at $18,725.

Tama, Iowa—To Thos. Carey & Sons Co., Clinton, for paving business district at $32,540 with brick.

Transcona, Man.—To the Cusson Lumber Co., St. Boniface, Man., 14 miles plank sidewalks at $22,722.

Troy, N. Y.—To John W. Davitt, city, for paving Tibbits avenue and Peoples avenue at $33,522 and $19,951.50, respectively, with bitulithic paving.

Urbana, Ohio—To Andrew Asphalt Paving Co., Hamilton, for Scioto paving at $10,-161.50; to J. O. Shoup & Co., Dayton, for paving various streets at total bid of $36,980.

CONTEMPLATED WORK.

Pittsburg, Pa.—County commisioners plan to expend $322,475 on roads. A. B. Hay, county solicitor.

Newark, Ohio—Construction of new sidewalks on sixty streets has been approved by street committee. Charles Wells, City engineer.

Bozeman, Mont.—About 22 blocks of paving, probably bitulithic, at estimated cost of $70,450.67. Carl Widner, city engineer.

Gridley, Ill.—To Driscol & O'Brien, Decatur, Ill., sanitary sewer system. Estimated cost $10,000.

SEWERS.

BIDS REQUESTED.

Albany, N. Y.—May 18, until 3 p. m., for an intercepting sewer and sewage disposal plant. Certified check, $20,000 for each. Isidore Wachsman, secretary board of contract and supply.

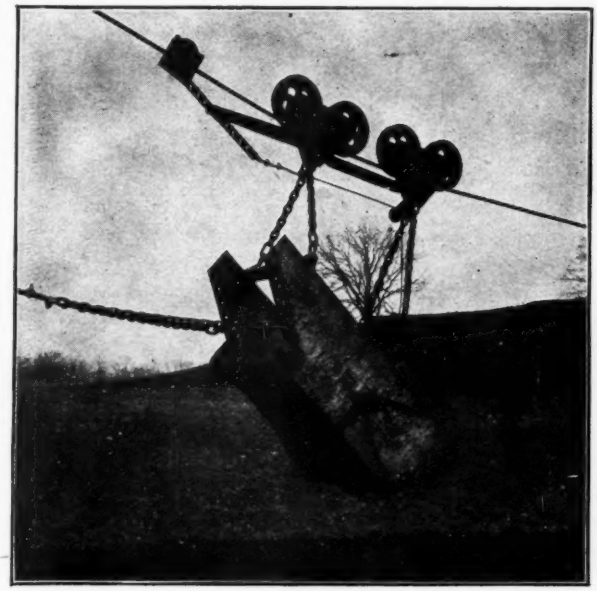
Chicago, Ill.—May 21, until noon, for excavation and collateral work on Section 12. Deposit required, $20,000 with each proposal. Thomas A. Smyth, president, board of trustees, Sanitary District, Room No. 700, 910 South Michigan avenue.

Dexter, Mo.—May 18, until 8 p. m., for sewerage system, including 7½ miles 6 to 12 inch pipe, 62 manholes, 25 flush tanks, and Imhoff tank. Webb Watkins, mayor.

Goshen, N. Y.—May 15, until 1:30 p. m., for system of sewers and sewage disposal plant. Certified check, $3,000, made payable to trustees of village. Geo. F. Gregg, president of village.

Indianapolis, Ind.—May 11, until 10 a. m., for reinforced concrete drain for carrying waters of Pogue's Run from New York street to White River as part of track elevation resolution No. 7. Certified check, 2½ per cent. Jos. A. Rink, president board of public works.

New Orleans, La.—June 17, until noon, for



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THE ATLAS PORTLAND CEMENT CO. PORTLAND ATLAS CEMENT 30 BROAD ST. NEW YORK

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to discriminating cement buyers —to those who put standardized high quality first—the men at the top of the architectural and engineering professions are using Atlas constantly and have for twenty years.

drainage system as follows: Contract 62-D, one 15-ton hand operated crane; contract 63-D, underground conduit; contracts 65-66-D lined and covered drainage canals. Certified checks, $50.00, $200.00, $1,000.00 and $3,000.00, respectively. Geo. G. Earl, general superintendent of sewerage and water board, Room 508 City Hall Annex.

Struthers, Ohio—May 20, until noon, for storm and sanitary sewer with house connections in Broad street from Bridge street to village limits. Jonah Richards, village clerk.

York, Pa.—May 15, until noon, for sanitary and storm sewers in a number of streets. G. A. Warner, city engineer.

CONTRACTS AWARDED.

Angola, Ind.—To VanDerwelle Bros., Grand Rapids, Mich., at $22,679, and Moritz & Lybarger, city, at $12,490, for about 21,000 lineal feet of pipe sewer.

Antwerp, Ohio—Installation of sanitary sewer system at cost of $30,000 is contemplated. Wm. P. Reid, mayor.

Boston, Mass.—Contract awarded Anthony Baruffaldi, Boston, for sewer construction in Section No. 3, South End sewer improvement, at $31,556.

Chesterton, Ind.—To Sela A. Smith, of Lake County, sewer system, at $19,000.

Connersville, Ind.—Construction of vitrified tile sewers is contemplated. W. L. Schaeffer, city clerk.

Fenton, Mich.—Installation of trunk sewer system is being considered. McFadden & Bergin, Flint, Mich., engineers. Mr. Olk, president of council.

Fort Lupton, Colo.—To Gordon Taylor Construction Co., Denver, installation sewer system, at $13,790.

Hamilton, Ohio—Plans have been presented for East Hamilton. Trunk line of storm sewer to cost about $64,000. Frank Weaver, city engineer.

Joliet, Ill.—Bids will be advertised for at once for construction of Third Ward sewer system. Estimated cost, $55,000. C. D. O'Callahan, city engineer.

Memphis, Tenn.—To V. Noll Construction Co., Chattanooga, Tenn., West Side storm sewer at $58,326.96.

Mount Rainier, Md.—Installation of sewerage and water systems and electric lighting plant being considered. Bond issue, $125,000.00.

Newark, N. J.—To Carrington Construction Co., Jersey City, for sewer section No. 13 of flume in Passaic, at $252,202.50.

Rochester, N. Y.—To Myers & McWilliams, Pittsford, sewage disposal plant in Irondequoit at $333,855.

Urbana, Ohio—To Cook & Cook, Clintonville, for sewage disposal plant at $3,707.05.

STREET SIGNS.

BIDS REQUESTED.

Chicago, Ill.—May 11, until 11 a. m., for installing about 500 street sign posts on concrete foundations and furnishing name plates for same. Certified check, 5 per cent. Ray Palmer, commissioner of gas and electricity.

Orlando, Fla.—Until May 28, for 110 white reinforced concrete street sign posts, height 8 feet 6 inches, supplied with iron rods near top for attaching four signs. On same date bids will also be received for ten white cement posts for "White Way" system on Orange avenue, from Lake Lucerne to Lake Ivanhoe. G. R. Ramsey, city engineer.

WATER WORKS.

BIDS REQUESTED.

Bruning, Neb.—May 12, until 7 p. m., for water works system and light plant to cost $11,778 and $7,308, respectively. C. G. Bruckert, clerk. Grant & Fulton, engineers, Lincoln, Neb.

Dexter, Mo.—May 18, until 8 p. m., for water works system, including 10-inch deep well and pumping station, 70,000-gallon tower tank, 6 miles 4 to 8 inch cast iron water pipe, 34 hydrants and 24 valve boxes. Certified check, $200.00. J. I. Moore, city clerk. Frank Wilcox, engineer, Syndicate Trust Building, St. Louis, Mo.

CONTRACTS AWARDED.

Allendale, N. J.—To Melrose Construction Co., 147 East 125th street, New York City, water works system to cost $37,300.

Boswell, Okla.—Contract will be awarded about May 13 for construction of water works system to cost $36,000. J. E. Davis, engineer, Caddo, Okla.

Carpentersville, Ill.—To Logan & Giertz Construction Co., Elgin, Ill., water works system at $19,467.

Jacksonville, Fla.—Contract for remodeling water works plant awarded F. W. Long, city, at about $35,000.00.

CONTEMPLATED WORK.

Averyville, Ill.—Installation of a water works system is being considered at cost of $30,000. Address board of local improvements.

Colfax, Wis.—Bond issue of $14,000 has been voted for installation of water works system. A. F. Thompson, engineer, Chippewa Falls, Wis.

Duxbury, Mass.—Plans are to be prepared at once for water supply, including driven wells, pumping station, stand pipe or reservoir, and about 14 miles of main. Engineer to be appointed shortly. Charles S. Clark, commissioner, advises he will be glad to receive suggestions from anyone interested in doing the work or furnishing supplies.

Morris, Okla.—Plans being prepared by Benham Engineering Co., Oklahoma City, Okla., for installation of water works system, bond issue $42,500. Bids will be received shortly.

Peoria Heights, Ill.—Plans being considered for installation of water works system to cost $50,000.

MISCELLANEOUS.

BIDS REQUESTED.

Akron, Ohio—May 15, until noon, for furnishing and erecting garbage reduction equipment. Certified check, $5,000. Ira A. Priest, clerk, city council. R. Winthrop Pratt, consulting engineer, Hippodrome Building, Cleveland, Ohio.

Boston, Mass.—June 15, until noon, for dry dock on South Boston Flats. Certified check, $10,000.00. Frank W. Hodgeon, chief engineer, directors of port, Boston.

Council Bluffs, Iowa—Bids will be advertised at once for street flusher and several new dump carts. Charles J. Duff, city clerk.

Idaville, Ind.—May 16, until 1 p. m., for heating and ventilating plant in new school building. Geo. B. Tam, trustee, Jackson Township, White County.

Little Rock, Ark.—Until May 12, for equipment for asphalt repairs and other repairs. Second-hand plants will be considered. Fletcher Chenault, clerk, board of public affairs.

Shippensburg, Pa.—John E. Coffey, clerk of boro, desires quotations on 18,000 to 20,000 feet of iron or wood 10-inch pipe for laying water mains.

St. Johns, Newfoundland. Installation of telephone service in St. John's is being considered. Further information can be obtained by addressing T. A. Hall, government engineer, St. John's.